Volume 13 Rabbits to Signaling

The GOLDEN BOOK ENCYCLOPEDIA

REVISED EDITION

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STATE INSTITUTE OF EDUCATION * Govt. of West Bengal *

The GOLDEN BOOK ENCYCLOPEDIA

NEW REVISED EDITION

VOLUME 13—RABBITS TO SIGNALING

IN SIXTEEN ACCURATE, FACT-FILLED VOLUMES
DRAMATICALLY ILLUSTRATED WITH MORE
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ACCURATE AND AUTHORITATIVE
ENTERTAININGLY WRITTEN AND ILLUSTRATED
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Rr

The letter *R* began as the picture of a head, 𓁶. The Egyptians used the picture in their hieroglyphic writing. After it was borrowed for the first alphabet its shape changed so that it was easier to write, 𐤓 . The Greeks wrote it first in this way, 𐤓 and then this, ꟼ . The Romans changed it to the shape we know.

R stands for several slightly different sounds. And it is pronounced differently in different parts of the English-speaking world. In some regions the letter is silent unless it comes before a vowel. Such words as *card* and *cod*, for instance, as some people say them, sound alike.

RABBITS Many other animals would go hungry if it were not for rabbits. Minks, foxes, weasels, and hawks and owls are among the animals that find rabbits good eating. So are people.

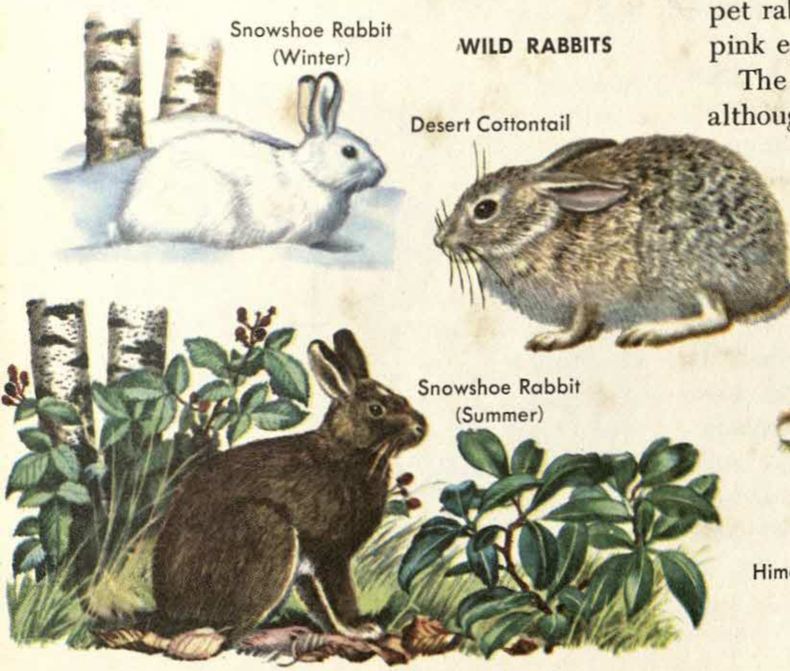
Rabbits have no weapons for fighting their enemies. But they have long, strong hind legs that let them make big leaps and bounds as they run away. They have big ears that tell them when an enemy is coming close. Their color as a rule helps them hide because it is about the same color as their surroundings. They can stay very still so that they do not give away their hiding place by moving. If they are running away from an enemy, they can stop suddenly and change direction fast.

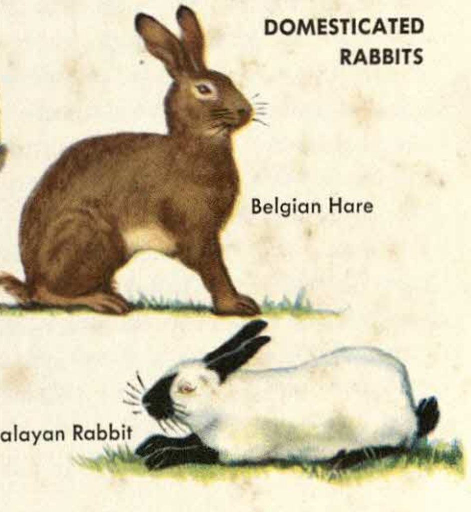
One other thing helps rabbits hold their own. They have many babies, or bunnies. A mother cottontail may have several litters in a year, with four or more babies in each litter. She lines the nest for them with hair she pulls from her own furry coat.

Rabbits themselves eat only plants. They have good teeth for gnawing and can eat bark and twigs as well as softer plant food.

There are several breeds of tame rabbits. Their ancestor was not the American cottontail but the wild rabbit found in Europe. Rabbits were first tamed in Europe. People raised them for food. In America they were first raised as pets. Now they are raised not only for pets but also for meat and fur and for use in laboratories. The pet rabbits most often seen are white with pink eyes. They are albinos.

The jackrabbit of the American West, although it is a very close relative of the


WILD RABBITS


DOMESTICATED RABBITS

rabbit, is not a rabbit. Neither is the snowshoe rabbit. Both are actually hares. Just as some hares are called rabbits, some true rabbits are called hares. The Belgian hare is a rabbit. True rabbits are born naked and blind. Hares are born with fur and with their eyes open. (See ALBINO; FURS; PETS; PROTECTIVE COLORING.)

RACES OF MANKIND Scientists call every different kind of animal in the world a species. The yellow-headed blackbird, for instance, is one species. The red-winged blackbird is another. The rusty blackbird is still another. Scientists give every species a scientific name. It is a Latin name, and in many cases it is long and hard to pronounce. The scientific name of the yellow-headed blackbird is *Xanthocephalus xanthocephalus.* The scientific name of the red-winged blackbird is *Agelaius phoeniceus.* The scientific name of the rusty blackbird is *Euphagus carolinus.*

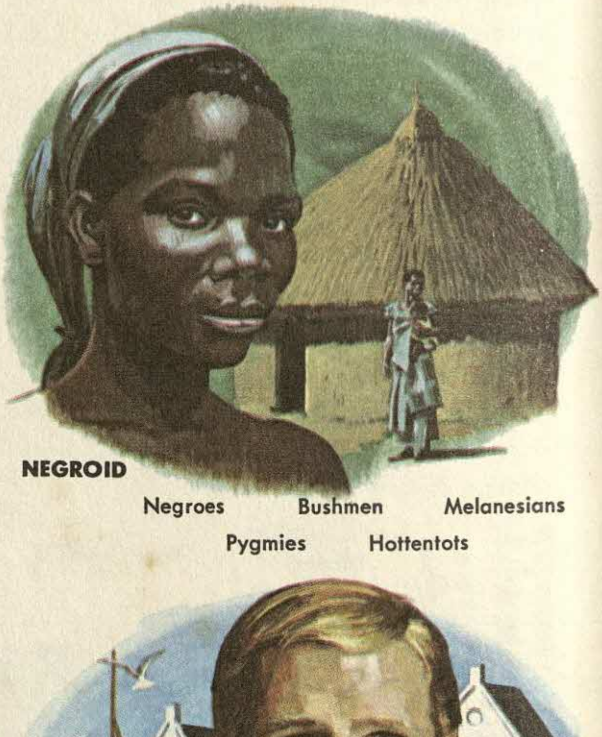
All the people in the world belong to the same species. An American Indian looks very different from a fair-haired, blue-eyed Swede. A Hottentot looks very different from a Japanese. But in spite of any differences in their outward appearance, people are all very much alike. Every single person in the world belongs to the species scientists call *Homo sapiens.*

Although all people are very much alike in the way they are built, some are more alike than others. An American Indian is more like an Eskimo than he is like an African Pygmy. An Arab is more like a native of India than like a Chinese. Scientists use likenesses and differences to divide the earth's people into races.

In dividing people into races scientists have used such things as head shape, face shape, texture of hair, shape of eyelid, cheekbone prominence, and nose and mouth shapes. They also use some less obvious things such as blood type, fingerprints, palm prints, disease resistance, and ability to taste certain tastes.

MONGOLOID

Mongols Malays Eskimos Chinese
Japanese American Indians



NEGROID

Negroes Bushmen Melanesians
Pygmies Hottentots

CAUCASOID

Nordics Alpines Mediterraneans

Some of the races are more alike than others. The different ones are generally thought of as falling into three big groups. These groups are commonly called whites, blacks, and yellows. The names are based on skin color. But they are not in many cases very good names. For some races in the white group have dark-brown skins. Some of the races in the black group have light-brown skins. And some of those in the yellow group have skins of reddish-brown. Other names given to these groups are Caucasoids, Negroids, and Mongoloids. A fourth group, the Australoids, includes the aborigines of Australia and a few little-known peoples of southern Asia.

The captions under the illustrations name some of the races in the three main groups. Each of these in turn includes many lesser races. There are hundreds of different races of human beings.

Many peoples belong in more than one of the big groups. The Polynesians of the Pacific are thought to be a Caucasoid-Negroid-Mongoloid blend.

Some people get races and religions confused. Some think, for instance, that the Moslems are a race. Instead they are followers of the religion called Islam. Almost all members of the Arab race are Moslems, but some are not, and there are many Moslems who are not Arabs.

When Hitler was the ruler of Germany, he said that he wanted his country to be a nation of pure "Aryans." It was a foolish thing for him to say, for Aryan is not the name of a race. It is a name that was once used for the group of languages called Indo-European and for the many different peoples who speak those languages. Besides, there is no such thing, scientists tell us, as a pure race and probably never has been. Hitler's idea of "Aryan" superiority was wrong, too. No race of people leads all the others in capability. Given equal opportunities, the people of one race can do just as well as those of another. (See ANTHROPOLOGY; MAN; NEGRO; PYGMIES.)

RADAR Almost everyone has heard echoes. Sound waves strike something solid and are bounced back. In radar, radio waves are echoed. They strike something they cannot go through and are bounced back. When they come back to the place they started from they are made to strike a special screen. It is much like a television screen. The screen shows in a simple way what the waves have hit. The operator has to learn to read the picture on his screen.

Radio waves travel as fast as light—186,000 miles a second. In radar the time it takes the radio waves to travel to an object and back tells how far away the object is. A radar operator gets the echo from an approaching plane in less than a second, from Venus in seven minutes.

For radar there must be a transmitter for sending out the radio waves and a receiver. There must be an antenna that makes the waves go out in a beam like the beam of a searchlight instead of going in all directions. An antenna is needed, too, for gathering in the reflected waves. Usually the same antenna is used for both sending and receiving.

In its early days radar was called *ra*dio *d*etecting *a*nd *r*anging. The name "radar" comes from the five letters in italics.

Radar helped save England during World War II. German bombers were doing great damage to English cities. But then radar began to be used to spot enemy planes approaching. Antiaircraft guns and fighting planes could go into action.

Radar helped greatly in attacking, too. It helped bomber pilots find their targets. Even if a city was hidden by smoke and fog a pilot could locate it by radar. Radar helped warships aim at enemy ships hidden by smoke screens.

Today many nations have radar stations on their borders. At Thule in Greenland there is an American manned station in the BMEWS (Ballistic Missiles Early Warning System). Other stations in this system are in Alaska and England.

But radar is not just for fighting and defense. It has many other uses. These are among them:

Helping pilots of airplanes and helicopters find out exactly where they are in fog or darkness.

Helping the operator in a control tower bring in planes for landing.

Tracking weather balloons to find wind speed and direction.

Helping the weatherman make his predictions by tracking hurricanes and locating approaching rain and snow.

Helping seamen navigate their ships and warning them of icebergs ahead.

Locating flocks of birds migrating and helping pilots avoid collisions with them.

Tracking UFO's—unidentified flying objects—often called "flying saucers."

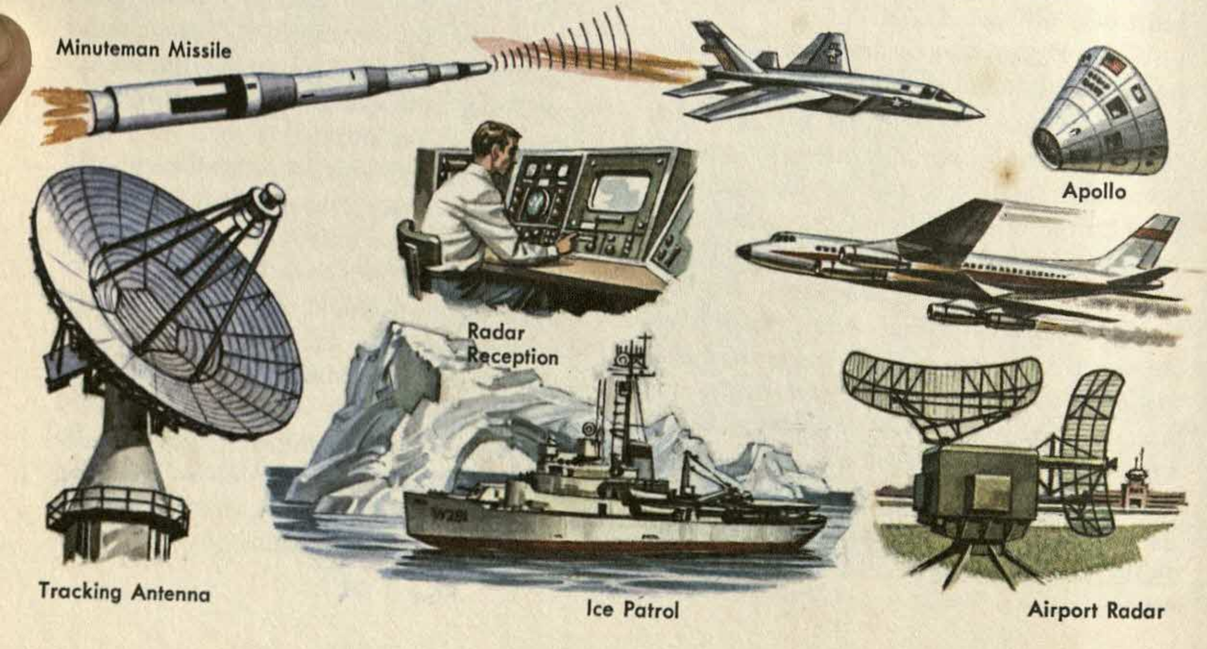
Locating the splashdowns of returning space vehicles.

Radar waves can travel millions of miles and back. After proving useful in mapping the moon, they are being made to "see" through the dense clouds on Venus and map that planet's surface. They are helping to map Mars, too. Scientists do not expect to use radar, however, in making discoveries beyond the solar system. (See AIRPORTS; ELECTRONICS; MARS; RADIO; RAIN; U.S. WEATHER BUREAU; VENUS.)

RADIO For most of us radio means listening to programs. We turn a knob to send a current of electricity flowing through our radio sets. We turn another knob to bring in the special program we want. Perhaps it is a news report from across the sea. Perhaps it is a baseball game only a few miles away. We hear the reporter's words as clearly as if we were standing beside him. We know about a home run as soon as it is made on the playing field.

But radio is helpful in other ways besides bringing us programs. Ships use it to find out exactly where they are and to ask for help if they need it. Airplane pilots use it to talk with the men in the control towers. Explorers use it to keep in touch with the world. Police calls are sent to squad cars by radio. Telephone companies use radio in some cases to carry telephone messages across the ocean. Unmanned satellites would be of little use if messages could not come down from them by radio.

Some people believe that sound travels all the way from the sending sets to the receiving sets. But this idea is wrong. Only radio waves travel from sending sets to receiving sets. The sound coming from a radio set is made in the set itself. At the sending set sound waves help to produce radio waves. These invisible radio waves



travel out into space in all directions. When they reach a receiving set they can be made to produce sound waves exactly like those at the sending station.

No one person can be called the inventor of radio. Many scientists have helped make it into the radio of today. Among the scientists who deserve a great deal of credit for it are the German scientist Heinrich Hertz, the Italian scientist Guglielmo Marconi, and the American scientist Lee De Forest.

Hertz found out that an electric spark sends out waves which can produce another spark a short distance away. By using electric sparks and the waves they send out, Marconi found a way of sending messages. This way became known as the wireless telegraph. Messages were sent in a code composed of dots and dashes.

The electron tube called the triode, invented by De Forest, was a big step forward in the development of modern radio. Electron tubes are now the heart of our sending sets and some of our receiving sets.

At a broadcasting station special electron tubes in the transmitter produce a carrier signal. This carrier signal is a current that flows back and forth an amazing number of times a second. At the same time that the carrier signal is being produced, the sound made in front of a microphone is modifying a current much as a telephone transmitter does. The current is then made stronger, or amplified. This strengthened current, called the audio signal, is sent on wires to the transmitter. There the audio signal is "mixed" with the carrier signal.

The combined audio and carrier signal rushes up and down an aerial, or antenna, unbelievably fast. When a radio announcer says, "This station broadcasts on a frequency of 800 kilocycles," it means that the station's current flows up and down the aerial 800,000 times each second!

The current rushing up and down the aerial sends radio waves out in all directions. These waves travel at the speed of light—186,000 miles a second.

Aircraft Traffic Control

Broadcasting

Radio Transmitter-Receiver

Ship-to-Shore Radio

Police Radio

When radio waves hit the antenna of a receiving set, they make a current flow back and forth in it. This current is like the one that flowed up and down the aerial of the sending station, but it is much, much weaker. Three important parts of the receiving set turn this tiny current into sound.

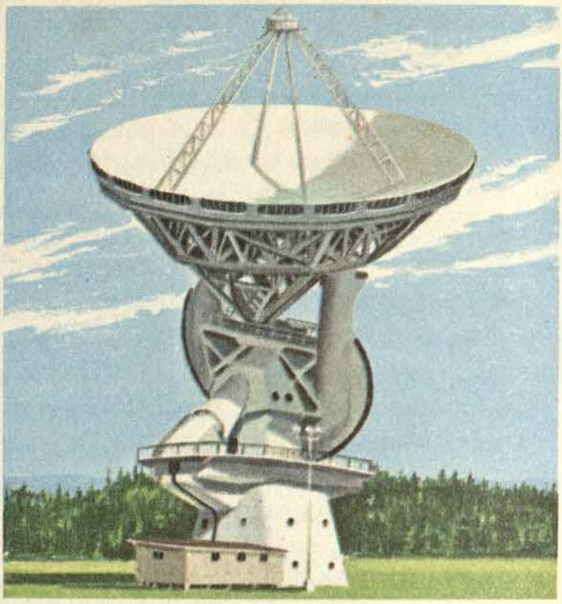
One is the tuner. Waves from many broadcasting stations may be striking the antenna. The tuner lets the listener choose the station he wants to hear.

The current produced by the waves from this one station goes to the detector. It is the job of the detector to change the current into one which can operate the loudspeaker. The detector must separate the carrier signal from the audio signal. The audio signal is then strengthened and sent to the loudspeaker. In the loudspeaker this current produces sounds just like those made in the broadcasting station.

Some of today's radio sets are AM sets. Some are FM. FM sets can be used only within 100 miles or so of the station broadcasting an FM program. Good AM sets can get programs or messages from thousands of miles away. The difference is in the waves the broadcasting station sends out. The advantage of FM broadcasting is that static does not interfere with it.

In many receiving sets tiny transistors are used in place of electron tubes. They are made of crystals of germanium. A transistor set may be pocket-sized.

Radio has done a great deal to make the world seem smaller. There are now over half a billion sets in use. We learn about interesting happenings almost as soon as they occur. The first really important radio broadcast in the United States was the report of the presidential election on Nov. 2, 1920. Station KDKA in Pittsburgh broadcast the word that Harding had been elected. Today radio has given way to some extent to radio-with-pictures—television. (See AIRWAYS; ELECTRONICS; INVENTIONS; SATELLITES; TELEVISION; TRANSISTOR.)



RADIO TELESCOPE In 1931 Karl Jansky, a young electrical engineer of the Bell Telephone Laboratories, was studying radio static that interfered with overseas calls. Night after night he heard sounds he could not account for. Finally he realized that they were from outer space.

Almost ten years later Grote Reber, another young electrical worker, built the first radio telescope in his backyard in Wheaton, Ill. He began studying the sky.

Now there are dozens of radio telescopes. With them scientists have found thousands of radio wave sources in the sky. Only a few are objects that can be seen with telescopes. The radio telescope gives us an extra window on the heavens.

Most radio telescopes have big dish-shaped antennas. A dish may stay in the same position. In Puerto Rico there is one of this kind 1,000 feet across. Or a dish may be movable so that it can be made to face any part of the sky. The biggest of these is at Jodrell Bank in England. It is 250 feet across. In some setups two or more antennas work together.

Some radio telescopes are equipped to use radar to find out about nearby heavenly bodies. Many radio telescopes also track satellites. (See RADAR.)

RADIUM The early alchemists spent most of their time trying to change common metals such as lead into gold. Many people laughed at the idea. The alchemists had no clear notion of what they were doing. They simply tried all sorts of strange "recipes" and hoped by magic to make the change take place. They wanted to make themselves rich.

Now scientists know that the alchemists were not entirely wrong. For it is possible for certain metals to change into others. The discovery and study of radium showed that this is true. The alchemists would be unhappy, however, because radium, which is thousands of times more expensive than gold, goes through a series of changes and becomes common lead.

Radium is one of the simple substances, or elements, that scientists call radioactive. Radioactive elements change all by themselves into other elements. As they do so, they send out powerful rays. These rays can go through many substances that light cannot go through. The rays from radium, for instance, can go through flesh and be used to treat such diseases as cancer.

A common use of radium is in paint. Paint containing very tiny amounts of this element is used on the hands of clocks and watches to make them glow in the dark. Chemicals in the paint give out flashes of light when hit by rays from the radium.

Carelessly used radium can cause terrible burns. Supplies of it must be kept in special containers with thick lead walls.

Pure radium is a shiny white metal. It is very heavy. But there is so little of it that no one has ever been bothered by its weight. Only a few pounds have been produced in the whole world.

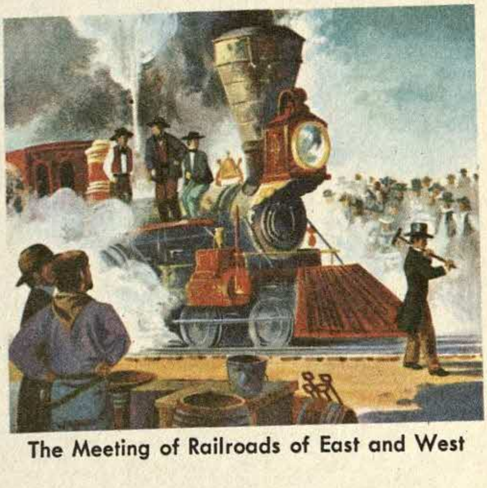
Radium was discovered a little more than 70 years ago by the French scientist Pierre Curie and his wife Marie. The story of their work is one of the really exciting chapters in the story of science. (See ALCHEMY; CURIE, MARIE and PIERRE; ELEMENTS; URANIUM.)

RAILROADS May 10, 1869, was an important day in the history of the United States. On that day a spike was driven that joined a railroad being built westward from Omaha, Neb., with a railroad being built eastward from Sacramento, Calif. The two roads were the Union Pacific and the Central Pacific. They met near Ogden, Utah. For the first time it was possible to travel by railroad all the way across the country.

Railroads now form a great network over the United States. In all, there are about 225,000 miles of them—just about enough to go to the moon. The country's railroads have had a great deal to do with building it into a strong nation.

It is easy to see how railroads got their name. They are truly roads built of rails. Standard rails are made of steel and are in sections 39 feet long. In most tracks heavy spikes are used to fasten the rails securely to wooden crossties. The ties are laid on beds of crushed rock, cinders, or gravel. Water can run off easily, and the ties stay firmly in place. Some of the newer tracks use rails welded into long lengths of half a mile or so—in some cases several miles. Another way newer tracks may be different is in the ties. Instead of being made of wood, they may be concrete. In Europe many tracks have steel ties.

The distance of the two rails from each other in a railroad track is called the gauge. Standard gauge is 4 feet, 8½ inches. Most



The Meeting of Railroads of East and West tracks in the United States are built on this gauge. It is possible for cars and engines of one railroad company to run on the tracks of other companies.

Many railroad tracks are double. One track is for trains going in one direction, and the other is for trains going in the other direction. If there is only one track, there must be sidings every so often. When two trains are approaching each other, one of the trains pulls off on a siding to let the other one pass.

Railroad companies build their tracks as nearly level and straight as they can. They avoid sharp corners and steep slopes. If a track must bend, it is laid in a big curve. If a mountain is in the way, the track may wind up and over it, or a tunnel may be dug through it. Bridges carry tracks over swamps, lakes, and rivers.

Passenger trains are not as common as they once were, but they are still an important way of carrying people from place to place. More than 300 million passengers a year ride on passenger trains in the United States. Carrying freight is an even more important work of railroads. The freight carried by American railroads amounts to more than a billion tons a year.

To carry their passengers and freight, railroads use many kinds of cars. On passenger trains we find coaches; diners; sleepers of several kinds; observation, or lounge, cars; and baggage cars. Some lines have dome cars. Among the many kinds of freight cars are tank cars, flatcars, boxcars, stockcars, refrigerator cars, and gondolas and hopper cars. Many freight cars have special fittings for carrying a particular kind of goods.

Much freight today travels piggyback on flatcars. Loaded truck trailers are put on the flatcars and then taken off the cars at the right city. The freight can be truck-delivered at the exact spot where it is wanted. Another way freight is now handled is in containers of a standard size for travel by air, truck, ship, or train. The containers

Railroad Yard

Courtesy of Esso of New Jersey

are quickly and easily transferred from one travel system to another.

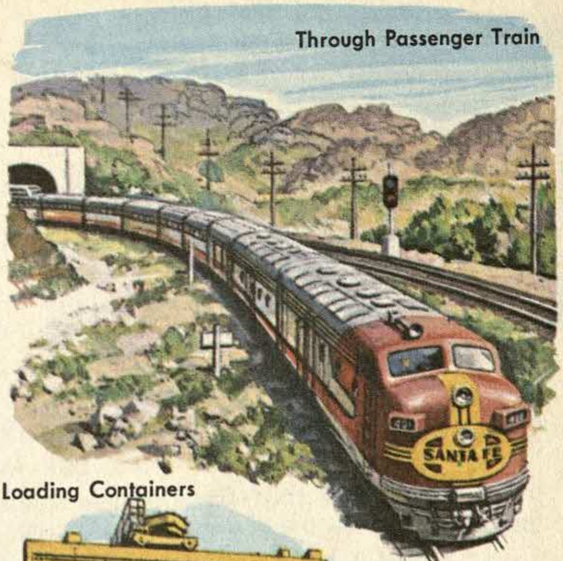
Locomotives of different kinds pull the trains. Most of them are diesel-electric locomotives. Others are electric. Once steam locomotives were common, but over most of the world steam is no longer used.

It takes more than half a million people in the United States to keep the country's railroads running. In addition to the train crews themselves, there must be many workers in the railway yards, the repair shops, and the railway stations.

With so many trains on the railroads, there must be good signal systems to prevent wrecks and keep the trains on schedule. Many different ways of signaling are in use. They range from long-established ways such as semaphores and colored lights to completely automatic electronic control systems. In some cases no crew is needed.

One of the most remarkable things about railroads is how fast they developed. One does not have to go very far back beyond the day the two roads met in Utah to find the very beginning of railroads. Their ancestors were roads of wooden rails over which, in the early 1600's, horses pulled coal cars away from English coal mines. But the modern railroad goes back only to 1825, when the Stockton and Darlington Railway was built in England. The first American railroad built for carrying both freight and passengers was the Baltimore and Ohio. It was started in 1827, but not till several years later did good steam locomotives make regular service satisfactory. How strange a train of those days, with its passenger cars like stagecoaches, would look beside a modern train!

Though railroads are not as important as they were before the days of automobiles, buses, trucks, and airplanes, they are still often the best way of moving things on land. Trains can travel in almost any kind of weather and carry any kind of goods. (See BRIDGES; LOCOMOTIVE; SUBWAY; SIGNALING; TUNNELS.)

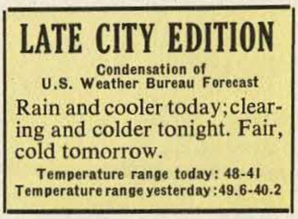

Through Passenger Train

Loading Containers

Track Maintenance

Signals

Dining Car



LATE CITY EDITION

Condensation of
U.S. Weather Bureau Forecast

Rain and cooler today; clearing and colder tonight. Fair, cold tomorrow.

Temperature range today: 48-41
Temperature range yesterday: 49.6-40.2

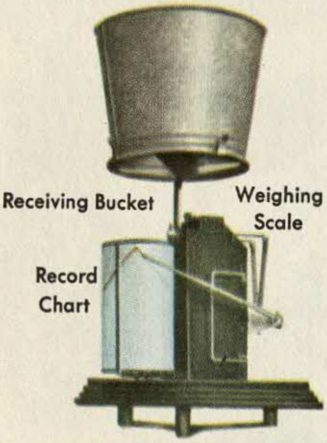
RAIN When water is falling from clouds we say that it is raining. The rain falls in drops. Sometimes the raindrops are small and they fall very gently. A rain of this kind is called a drizzle. Sometimes the rain comes down so fast that no one can see the separate drops. A hard rain of this kind is often called a cloudburst. "Cloudburst" is not really a good name for a heavy rain, for a cloud cannot burst. There is nothing on the outside of a rain cloud to shut in the drops of water.

Even the smallest drops of rain are much, much larger than the tiny drops of water most clouds are made of. A big raindrop is several million times as big as an ordinary cloud droplet. Cloud droplets may bump into one another and join to form drops big enough to fall. Or, high in a cloud, the droplets may help build up big snowflakes. The big snowflakes then melt as they fall through warm air.

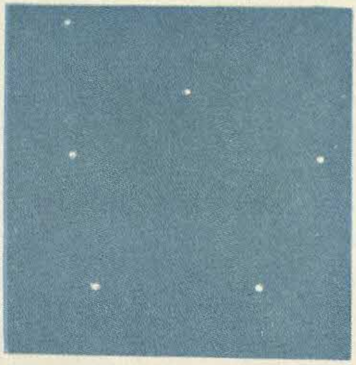
Once in a while it rains when there are no clouds to be seen. What happens is this: There is a cloud several miles above the ground. Rain starts to fall from it. The rain has such a long way to go that the cloud has disappeared by the time the rain has been able to reach the ground.

Rainfall is measured in inches. If the weatherman tells us that we have had a

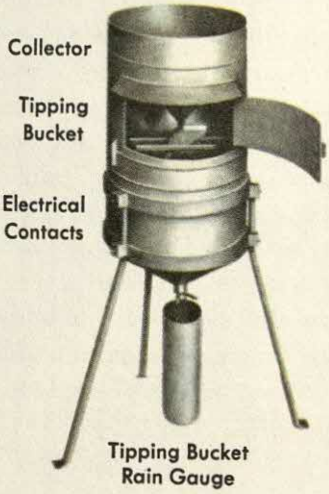
Recording Rain Gauge
(Housing Removed)



Cloud Droplets (Enlarged)



Smallest Raindrop (Enlarged)



Tipping Bucket
Rain Gauge

one-inch rain, he means that enough rain has fallen to make a layer an inch deep on level ground if none sank in. Rain gauges catch rain and measure it. The pictures show two kinds of rain gauges. The weatherman also measures rain by radar.

A one-inch rain is a heavy rain, but in cloudbursts the rain may be much heavier. Downpours of an inch in just one minute have been recorded on occasion. The heaviest rainfall for 24 hours was recorded on Reúnion Island in the Indian Ocean in March, 1952. Almost 74 inches fell! The record for one month is over 100 years old. During the month of July, 1861, more than 366 inches fell in Cherrapunji, India.

In some parts of the world rain is almost unheard of. In Arica, Chile, it takes about 50 years of rainfall to measure an inch.

Often heavy clouds cover a region without dropping any rain or snow. A few years ago, as a way of fighting drought, many experiments were carried on to try to make rain fall from such clouds. Chemicals to make raindrops form were dropped on the clouds from airplanes flying above them. But such cloud seeding did not prove helpful enough in bringing rain to regions suffering from drought to be important. (See CLOUDBURST; CLOUDS; HAIL AND SLEET; SNOW; WEATHER.)

RAINBOW After a summer shower there is often a rainbow in the sky. It is made by sunlight shining through tiny drops of water in the air. The tiny drops of water break the sunlight up into the colors it is made of. These colors are violet, indigo, blue, green, yellow, orange, and red. The initial letters of the rainbow colors spell "vibgyor." This is not a real word, but remembering it helps people remember the order of the colors in a rainbow. Some people remember the initial letters by putting them the other way round—"Roy G. Biv."

The colors in a rainbow shade into one another. It is hard to pick out indigo as different from blue. In fact, many people say that there are only six colors in the rainbow. They leave out indigo.

A rainbow disappears as soon as there are no longer any raindrops in the air. The reason that a rainbow usually comes after a shower is that not till then do the clouds begin to break away so that the sun can shine through the raindrops.

A rainbow is always in the part of the sky opposite from the sun. In the morning, when the sun is in the east, a rainbow is always in the west. In the afternoon, when the sun has moved to the west, a rainbow can only appear in the east. There cannot be a rainbow at noon.

Once in a while there is a double rainbow. In an ordinary rainbow red is at the top and violet at the bottom. In a second rainbow the colors are turned around.

Little rainbows can often be seen in the spray of a waterfall. They can even be seen in the spray of fountains and sprinklers.

There is an old saying that there is a pot of gold at the end of the rainbow. No one could ever find it even if there were. No one could ever get to the end of a rainbow. No matter how far anyone traveled toward a rainbow the rainbow would always be ahead of him. "Chasing a rainbow" means trying for something impossible to get.

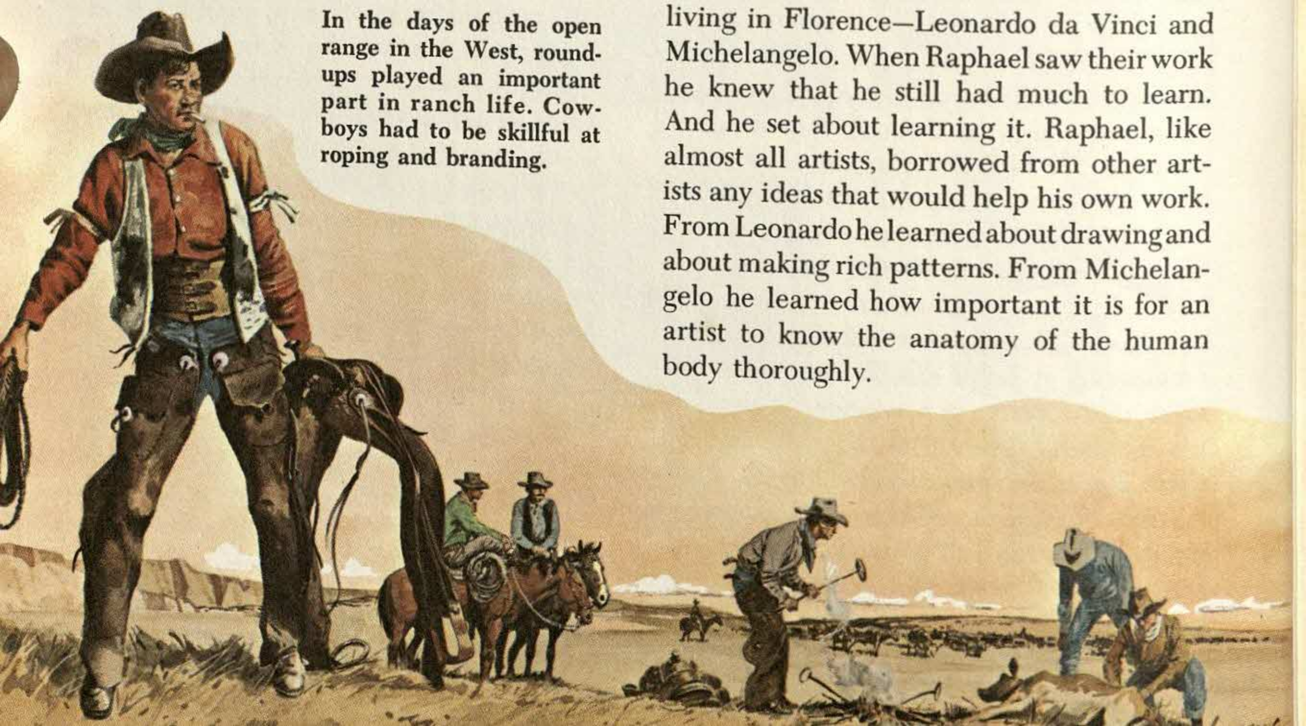
There are many myths about rainbows. The rainbow, some of them say, made a bridge by which the gods could come down to earth. (See COLOR; LIGHT.)

RANCHES Every boy or girl who likes cowboy stories knows about ranches. For ranches and cowboys go together. Ranches are big farms used chiefly for raising cattle or sheep. They are in parts of the world where the land is good for grass rather than for such crops as corn, wheat, and cotton. In the United States the ranches are in the West and Southwest and in Hawaii. One of these ranches may be so big that it has thousands of cattle or sheep on it. A single sheep ranch takes up the whole island of Niihau in Hawaii. Australia, Canada, Argentina, and Brazil have big ranches, too.

Ranch buildings are one-story buildings. They fit well into the grasslands. There is no point to having buildings two or three stories high when there is so much open space. People have come to like the low houses on ranches so well that many homes even in cities are built like ranch houses.

Life on a ranch is not as exciting as stories and motion pictures make it seem. There is much hard work to be done. But many people like it because it keeps them out of doors most of the time.

Some ranches are called dude ranches. Paying guests spend vacations at dude ranches. They enjoy riding horseback and being out of doors. (See RODEO.)



In the days of the open range in the West, roundups played an important part in ranch life. Cowboys had to be skillful at roping and branding.

RAPHAEL (1483–1520) Many great artists have not been called great until after they were dead. Raphael's story is very different. The people of his time recognized him as one of their greatest artists. They called him *divino pittore,* which means "divine painter." The sweetness and charm of his pictures of the mother of Jesus—his Madonnas—won immediate praise. Just as his Madonnas were loved by all kinds of people, the artist was loved by rich and poor, young and old. When he died, such crowds came to his funeral that it seemed all Rome was there.

Raphael—his full name was Raffaello Santi—was born in Urbino, Italy. His father, Giovanni Santi, was a painter and poet. The boy was left an orphan when he was 11. It was clear that Raphael had remarkable talent. His father, although not himself an outstanding artist, had given him lessons in painting. At 16 he entered the workshop of the artist Perugino at Perugia. In almost no time he was painting as well as his master. He began to paint pictures of his own in addition to helping Perugino.

When he was 21, Raphael visited Florence for the first time. The visit was a short one, but he soon went back to Florence to live. At the time two of the greatest artists the world has ever known were living in Florence—Leonardo da Vinci and Michelangelo. When Raphael saw their work he knew that he still had much to learn. And he set about learning it. Raphael, like almost all artists, borrowed from other artists any ideas that would help his own work. From Leonardo he learned about drawing and about making rich patterns. From Michelangelo he learned how important it is for an artist to know the anatomy of the human body thoroughly.

Raphael stayed in Florence for two or three years. During these years he painted many of his most famous Madonnas.

The beauty of these paintings has made them popular all over the world. Today they may be seen in museums in Italy and in Vienna, Madrid, London, Paris, Munich, Berlin, New York, and a few other cities. The most famous Madonna of all, "The Sistine Madonna," was the last one Raphael painted. It is in a museum in Dresden, Germany. A Raphael Madonna is almost always the most popular painting in any museum that has one.

In 1508, at the age of 25, Raphael went to Rome. At that time the Basilica of St. Peter was being built, and the pope was having a great deal of painting done in the Vatican. At the same time that Michelangelo was painting the ceiling of the Sistine Chapel, Raphael was at work in the apartments of Pope Julius II. He filled these rooms with magnificent frescoes. Most of these frescoes have either religious, philosophical, or mythological subjects. In his paintings Raphael used the faces of many people living in his own time. In one painting he used his own face.

Raphael did more than paint pictures. Before he was 35 he was doing at least half a dozen different kinds of work. He had become the architect of St. Peter's. He made plans for private palaces. He had charge of digging up and saving relics of ancient Rome. He designed mosaics and tapestries. And he kept on painting frescoes and portraits. He could not carry out all this work without help. He had about 50 younger artists working with him.

Raphael, a handsome and charming man, was popular with both men and women. His work brought him great riches and a high social position. But he did not live long to enjoy them. He was always frail, and he was tired from overwork. Late in March of 1520 he caught a fever. He died on April 6, 1520, his 37th birthday. A self-portrait of the great artist hangs in the Uffizi Gallery in Florence. His last masterpiece, the "Transfiguration," is in the Vatican. Unfinished at the time of his death, the painting was completed afterward by some of his pupils. (See HISTORY; MADONNA; MICHELANGELO; PAINTERS AND PAINTING; RENAISSANCE.)

RATEL The ratel is found in Africa and southwestern Asia. Another name for it is honey badger. It looks a great deal like a badger, and honey is one of its favorite foods. It has strong claws that are useful in digging honey out of hollow trees. Its thick skin and long hair keep it from being stung by the bees it disturbs.

Most animals are darker on top than underneath. The honey badger is just the opposite. Its back is very much lighter than the under part of its body. In fact, the ratel looks as if it were wearing a light blanket on its back. It hunts chiefly at night. Most of the day it spends in its burrow. In addition to honey, a ratel eats small animals such as ground squirrels. Occasionally it may capture a gazelle, and it may even eat a deadly snake. Little birds called honey guides help ratels find

Ratel

honey. When they have located a bee tree, they lead the ratels to the tree by their loud chattering. The birds eat the scraps of comb the ratels leave.

The African natives are very much afraid of this animal. It is fearless, and it is very strong for its size. Men who ship honey badgers to zoos have found that these animals can claw their way out of any box that is not lined with metal.

RAYON Up till nearly the beginning of the 20th century all cloth was woven out of fibers from plants or animals. By far the most beautiful fiber was silk. But it was expensive. A great many people could never afford clothes made of silk. And no other cloth looked at all like it.

Now there are other kinds of cloth that look much like silk. And some of them are much less expensive. They are woven of man-made fibers. The oldest of these man-made fibers is rayon.

A French scientist, Count Hilaire de Chardonnet, began making rayon in 1891. The material he used was cotton. With chemicals he changed the cotton into a thick liquid that looked like honey. He squeezed this liquid through holes the size of a pinpoint. It came out in fine threads. The threads were then hardened in warm air. Later he used a solution of alcohol instead to harden them. The threads were twisted into thicker threads, or yarn, which could be woven into cloth.

The new fiber was not called rayon at first. It was called artificial silk. It did not get the name rayon until about 35 years later, after it had crossed the ocean and was being made in the United States.

No one liked rayon much in the beginning. It did not look like real silk. Soon, however, it was improved. By the time it got the name rayon it was beginning to be popular. Today over a billion pounds of rayon are made and sold every year.

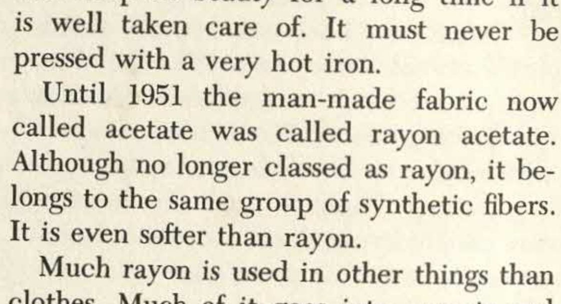
Now three different kinds of rayon are manufactured: viscose rayon, cupra rayon, and saponified acetate rayon. All three kinds are made of wood pulp instead of cotton. And for none are the same chemicals used to change the wood to liquid that Chardonnet used in making rayon.

Rayon can be dyed beautiful colors. It will keep its beauty for a long time if it is well taken care of. It must never be pressed with a very hot iron.

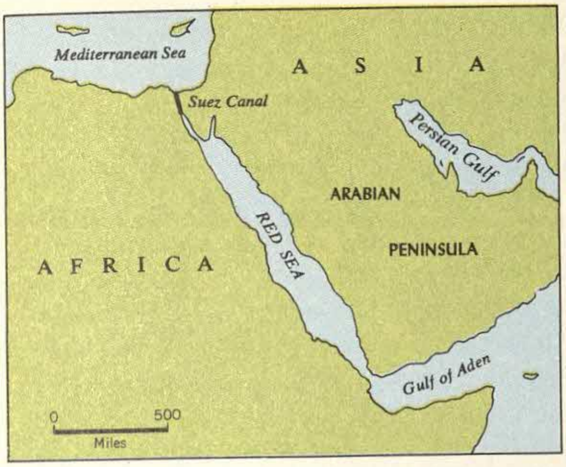
Until 1951 the man-made fabric now called acetate was called rayon acetate. Although no longer classed as rayon, it belongs to the same group of synthetic fibers. It is even softer than rayon.

Much rayon is used in other things than clothes. Much of it goes into carpets and such things as tires and conveyor belts. (See FIBERS; SILK; TEXTILES.)

REBUS One kind of riddle is called a rebus. It is a story written partly in pictures. A picture may stand for a whole word or it may stand for only a part of a word.



The answer to this rebus is: Someone saw many people race by. They would not stop to tell why they were all in a rush.



RED SEA The Red Sea really is red. It gets its color from billions of tiny reddish plants called algae that grow in it.

The Red Sea is an arm of the Indian Ocean between Africa and Arabia. Only a narrow strip of land separates it from the Mediterranean. The Suez Canal now crosses this strip of land. One of the world's most important ocean routes goes from the Mediterranean through the Suez Canal into the Red Sea. From there it goes on to the Far East. (See SUEZ CANAL.)

REED, WALTER (1851–1902) In a way Walter Reed was a detective. For he succeeded in tracking down two public enemies. He found out that the common housefly carries typhoid fever and that one kind of mosquito carries yellow fever.

As a boy Walter Reed lived in Virginia. His father was a minister there. Walter was only 16 when he entered the University of Virginia to study medicine. He asked the officials of the university whether he could take the examinations as soon as he thought he was ready. They agreed, never dreaming that he would be able to pass them within two years. But he was. He was the youngest student ever to graduate from the medical school of the University of Virginia.

After a few years in New York, Reed became an army doctor. He was sent to a garrison in Arizona, where he stayed for some dozen years. There he doctored not only the soldiers of the garrison but also all the sick people round about. The life was hard, especially since there were unfriendly Indians in the region.

From Arizona Reed was sent to Baltimore. He had a chance to study in the famous Johns Hopkins University there. Soon he became a professor himself in the Army Medical School in Washington. His first big job was to find out why there was so much typhoid fever in army camps. He found out that flies carrying germs to the soldiers' food were largely to blame.

At that time yellow fever was even more of a problem than typhoid. It was very common in Cuba and Central America, and there had been many epidemics of it in cities in the United States. Thousands of people had died in those epidemics. In 1900 Reed and several other army doctors were sent to Cuba to study this disease.

Earlier a Cuban doctor, Carlos Juan Finlay, had named a mosquito as the carrier of yellow fever. Reed thought his idea good.

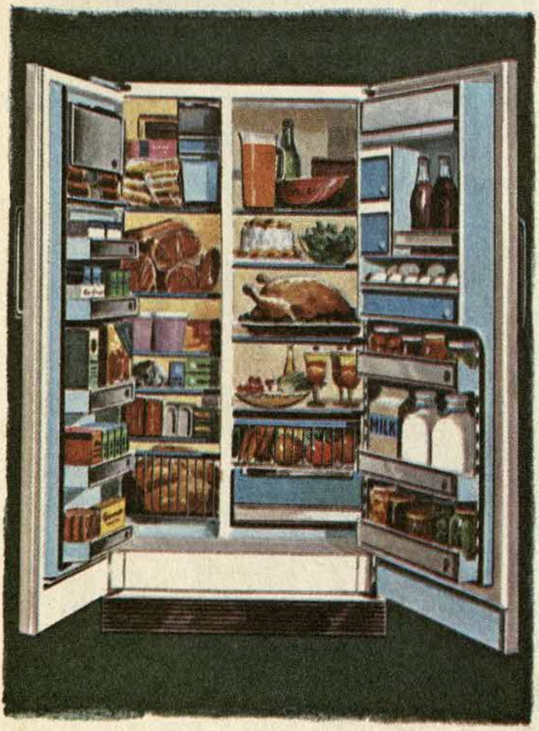
But the only way to find out was to let some of the mosquitoes bite people sick with yellow fever and then well ones. Several brave people offered to let themselves be bitten. Three got yellow fever but they all got well. Later, however, Jesse Lazear, the doctor in charge of the mosquitoes used in the project, was accidentally bitten. He got the disease and died.

More experimenting made Reed sure that only mosquitoes could carry yellow fever. The way to get rid of yellow fever was then clear—get rid of the mosquitoes.

In Havana, Cuba, a campaign to destroy mosquitoes brought an end to yellow fever there. Killing mosquitoes did away with yellow fever in other places, too. Today there is little of it.

Reed died of appendicitis soon after he saw Havana free from yellow fever. To help people remember him and his work, the government named the big army medical center in Washington, D.C., for him—the Walter Reed Army Medical Center. (See MOSQUITOES; PANAMA CANAL.)

Side-by-Side Refrigerator-Freezer



REFRIGERATORS Long ago people found that keeping foods cool helps keep the foods from spoiling. Besides, many foods taste better when they are cold. Refrigerators, therefore, are important.

The first refrigerators made were simple iceboxes. Ice was cut from lakes and ponds in the winter and stored in deep pits or in icehouses to be used in the summertime. An icebox was built to hold a cake of ice in one part and food in another part. As the ice melted, it cooled the air around it. The food in turn was cooled by the air. As soon as one block of ice melted, another was put in. Today we have mechanical refrigerators, which are much more convenient to use. Many of these refrigerators are run by electricity.

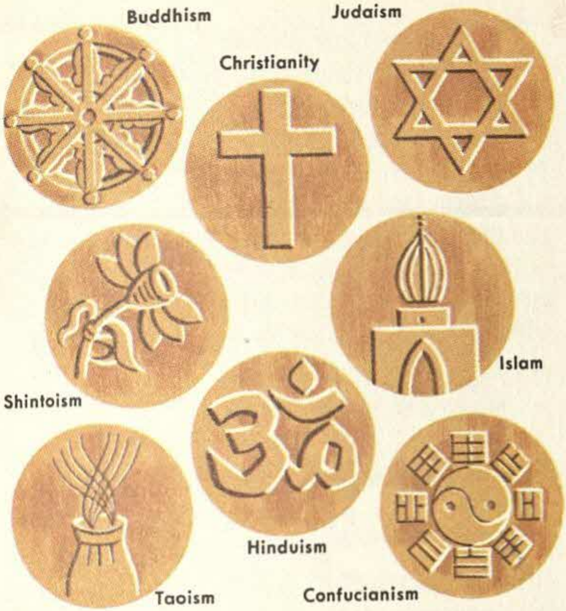
Most of us have used fans to cool ourselves on hot days. Fanning cools us because it makes our perspiration evaporate faster. Most refrigerators make use of the fact that evaporation is cooling.

The common electric refrigerator works in this way: A liquid called a refrigerant evaporates very fast in the cooling coils. As it evaporates it takes heat away from the food in the refrigerator. It makes the water in the freezing trays freeze into ice cubes. After the liquid evaporates, the gas formed goes to a compressor and then to a condenser. They change the gas back to a liquid. The liquid returns to the cooling coils and evaporates again. The same refrigerant is used over and over. An electric motor drives the compressor.

This same method of cooling operates in many freezers. In freezers the temperature is kept below freezing. Evaporation has to go on faster than in refrigerators.

Refrigerators of the kind called thermoelectric have no motors and no liquid to evaporate. They depend on the effect materials known as semiconductors have on one another when a current of electricity is sent through them. At present thermoelectric refrigerators are expensive. (See AIR CONDITIONING; HEAT.)

TUTE OF EDUCATION
Bengal



RELIGIONS OF THE WORLD From very early times people have believed in one god or in more than one. They have worked out ways of worshiping their god or gods. They have worked out beliefs as to what is right or wrong and what comes after death. Their beliefs and their ways of worshiping make up their religion.

There have been many religions in the history of the world. Some of the religions of today have only a few followers. Some of them have millions.

This list names the leading religions of today and tells in round numbers how many followers each one of them has.

Buddhism	168,000,000
Christianity	969,000,000
Confucianism	365,000,000
Hinduism	417,000,000
Islam	479,000,000
Judaism	13,000,000
Shintoism	69,000,000
Taoism	53,000,000

Wars have been fought to force people to accept a different faith. And some people have been badly treated because of their religion. Religion played a big part in the settling of the United States. Many settlers were seeking a place where they could worship in their own way. (See BUDDHA; CONFUCIUS; JESUS; MOHAMMED.)

REMBRANDT VAN RIJN (1606-1669) Rembrandt, one of the greatest artists of all time, was born in Leiden in the Netherlands. His father was a miller. As a child Rembrandt liked to sketch the sun coming in a tiny window and making a streak of light on the inside of his father's windmill. He carried this interest in light and shadow throughout his life.

Much of Rembrandt's 63 years was spent in Amsterdam, then the richest city in Europe. In some of his work we see the rich clothes and jewels worn by people there.

During the first ten years of his career in Amsterdam Rembrandt was a famous and fashionable painter. Then a series of misfortunes that all but ruined him began. His wealthy and much loved wife died soon after the birth of a son. People who wanted their portraits painted stopped coming to him. He fell into debt. Finally he had to sell his fine house and furniture, and even his rich velvet clothes.

This is what happened that was largely responsible for ruining the sale of his paintings: The Amsterdam Civic Guard paid him to paint them. Since he liked light and shadow, he painted the men as they were leaving the armory at noon to go on duty. The men still inside were in such deep shadow that they could not be recognized. The men in the sunlight, of course, showed up well. But their satisfaction did not make

3382

up for the anger of the others. The picture, called "The Night Watch," is one of Rembrandt's greatest.

Poverty did not keep Rembrandt from painting. The housekeeper, who had come not long after his wife's death to care for the baby, warded off creditors. So, too, as he grew up, did his son Titus. Since Rembrandt was too poor to hire models, he painted his housekeeper, his son, and, with the help of a mirror, himself. He painted the poor, the lame, the blind, and the sick.

Other Dutch artists of the time painted such things as dishes, tiles, and cloth of lovely texture just for their beauty. They painted rooms with handsomely dressed people in them. Rembrandt was greater because he painted people so that we can tell how they felt and what they thought. He painted their personalities, not just their clothes. Rembrandt was a great artist who was far ahead of his time. (See PAINTERS AND PAINTING.)

RENAISSANCE For several hundred years after the fall of the Roman Empire in the West in 476, civilization in Europe in some ways went backward. Most of the writings of the Greeks and the Romans were forgotten. There were very few scholars and artists. There were no strong governments. Fighting or working hard to get a bare living filled the lives of most of those who lived then.

But in time the people of Europe began making big strides forward. Finally their interest in the learning and art of the past, as well as their own achievements, became so great that the age in later centuries was given the name of Renaissance. "Renaissance" means "rebirth."

Since the rebirth of interest in learning and art was gradual, it is hard to say exactly when the Renaissance began. Some people think that the best date for its beginning is the date when printing was invented in Europe—about the middle of the 15th century. It is certainly true that the invention of printing gave interest in learning a great boost.

Gutenberg Bible

Astronomical Globe

Lorenzo the Magnificent

The Renaissance began in Italy. From there it spread over the rest of Europe. New interest in the writings of the ancient Greeks and Romans was a part of it. But the "rebirth" spread into other fields than literature—into art and music, and into science and exploration. Among the great names of the Renaissance are those of writers, painters, sculptors, scholars, explorers, and scientists. Some rulers, moreover, played an important role.

Of the rulers, Lorenzo the Magnificent was one of the most colorful. He was for many years the ruler of Florence, in Italy. His help encouraged a number of artists and writers who became famous. Leonardo da Vinci, painter, inventor, and one of the great men of all time, belongs in the Renaissance. So does Erasmus, a truly great scholar. Michelangelo, Raphael, Titian, Holbein, Andrea del Sarto, Copernicus, Vasco da Gama, Columbus, and Shakespeare are a few of the other greats of this age.

The Renaissance did not have any sudden ending, just as it did not have any sudden beginning. The death of the famous Queen Elizabeth I of England in 1603 is sometimes given as the end of the period.

Of course, the interest in art and learning did not end with the end of the period. But other interests were added. The development of trade and the settlement of the New World were two of them. In many, many ways the people of Europe today are better off than they were during the Renaissance. But it must have been a thrilling time to many who lived in it. (See DARK AGES; EXPLORERS; MIDDLE AGES; OPERA; PAINTERS AND PAINTING; PRINTING; SCULPTURE.)

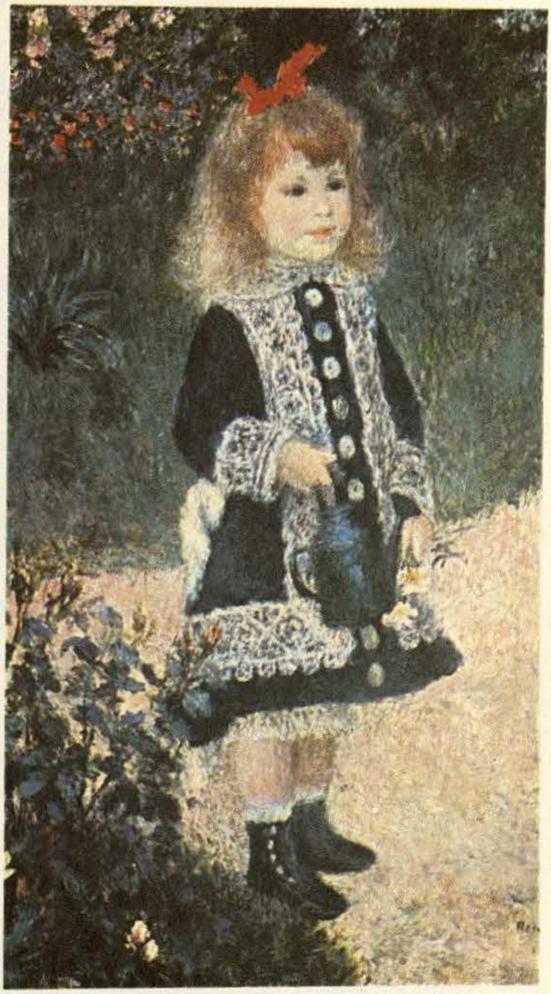
RENOIR, PIERRE AUGUSTE (1841–1919) Among French painters Renoir ranks high. When Renoir was a boy in Limoges, he painted on white porcelain to earn money for his food and clothing. He painted with very brilliant colors. Even though he was working for his living, he enjoyed every minute of his painting because he could work with bright colors.

Renoir never lost his love for color. He continually experimented with it when he grew to manhood and became a painter of pictures. He often began a picture by painting a scene or person in his own town so that his drawing would be right. But he then finished the picture with colors far more brilliant than the colors he saw in his surroundings.

Sometimes Renoir traveled to other countries—to Algeria, for instance—where the sun was very bright and the flowers were brilliant red, orange, blue, and violet. After painting in sunny climates he remembered the colors he saw there and used them in other scenes. His colors are often called jewel-like.

When some artists use bright colors together, the result looks cheap. Renoir's colors never look cheap, partly because he studied the science of color.

When Renoir painted human flesh, it looked warm and alive. When he painted eyes, they looked very bright. Renoir used lovely colors in his paintings, and he painted happy subjects.



National Gallery of Art, Washington, D.C.—Chester Dale Collection

"A Girl with a Watering Can," Renoir

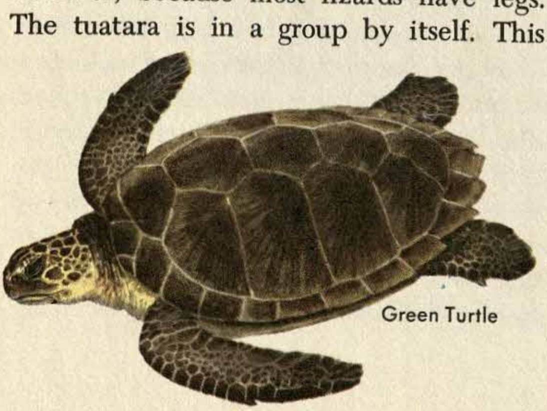
When Renoir first began to paint pictures, he and his friend Monet, another French painter, painted in a style, later followed by other painters, called Impressionism. He soon, however, outgrew this style of painting. The Impressionists put red and blue next to each other in a painting and let the eyes of the people who looked at the painting mix them into purple. They put blue and yellow next to each other and let people's eyes mix them into green. The Impressionists were more interested in light than in form. Renoir grew to like form. In his paintings the people, as in the picture shown, look real—they do not look as if they were made of cardboard. (See PAINTERS AND PAINTING.)

The largest dinosaurs were the largest land animals that ever lived.

REPTILES A hundred million years ago there were many more reptiles than there are now. They were everywhere—on land, in the air, and in the waters. There were so many of them that this bygone age is now called the Age of Reptiles.

Many of the kinds of reptiles that lived during the Age of Reptiles can no longer be found. Even the dinosaurs, which once ruled the earth, are all gone.

The reptiles living now are divided into five groups. The pictures show one reptile from each of the five groups. The two best-known groups are the snakes and the turtles. Snakes are known by their shape and turtles by their shells. The alligators and crocodiles are larger but are not found in so many places. Lizards are close relatives of the snakes. They look quite different, however, because most lizards have legs. The tuatara is in a group by itself. This reptile is found only on some small islands near New Zealand.



Green Turtle

The word "reptile" comes from a Latin word meaning "to creep." Whether they have short legs or no legs at all, reptiles move about on land chiefly by creeping.

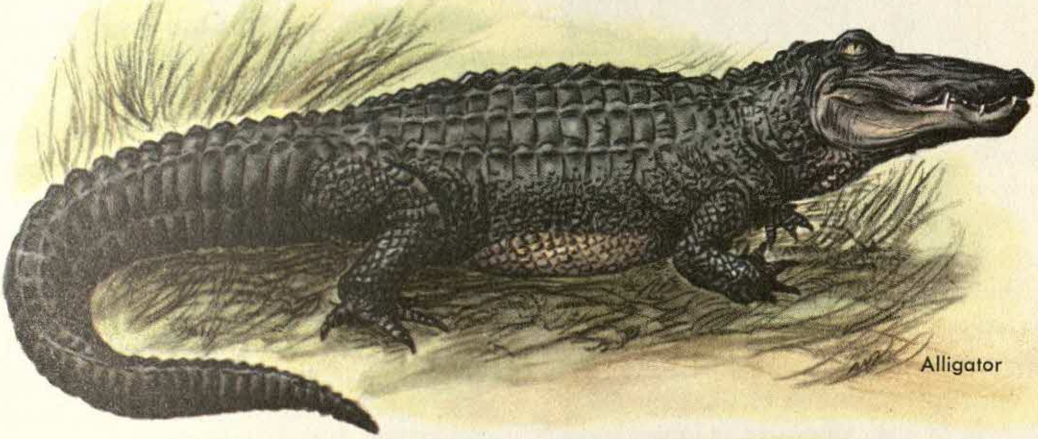
Although many reptiles spend much time in water, they are really land animals. They have lungs, and most of them depend on land life for food. Reptiles are covered with dry scales. They are not slimy.

Most reptiles lay eggs. Those that do, lay their eggs on land. The eggs are well protected by a tough outer covering. A few reptiles are live-bearing—that is, their young are born live, not hatched.

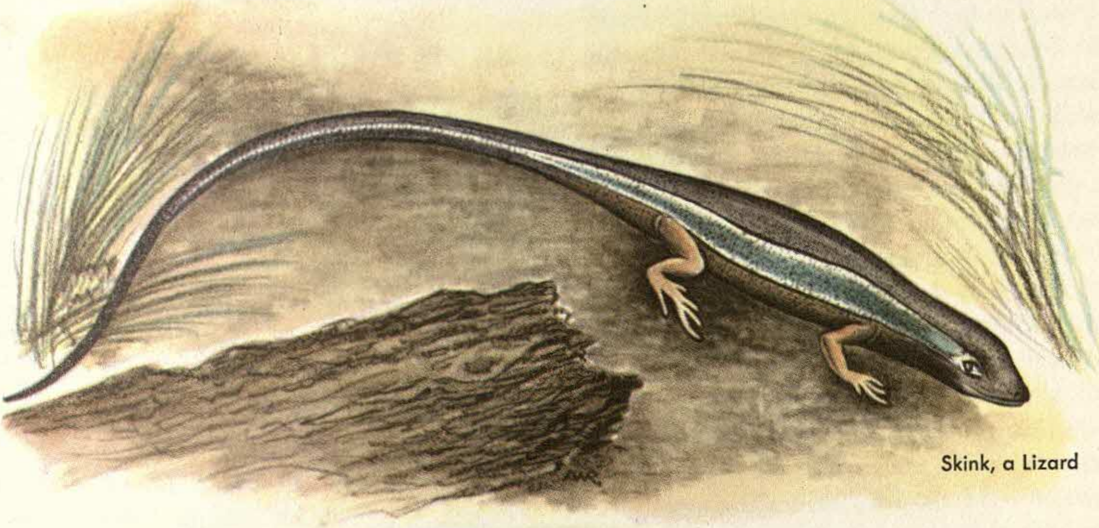
All reptiles, like fishes and amphibians and unlike birds and mammals, are cold-blooded. Therefore, reptiles that live in lands with cold winters must hibernate.

A few reptiles are used for food. The leatherlike coverings of some are used for making such things as purses, shoes, belts, and luggage. But reptiles as a group are far less important to us than fishes, mammals, and birds. (See ALLIGATORS AND CROCODILES; DINOSAURS; LEATHER; LIFE THROUGH THE AGES; LIZARDS; SNAKES; TURTLES; VERTEBRATES.)

Coral Snake

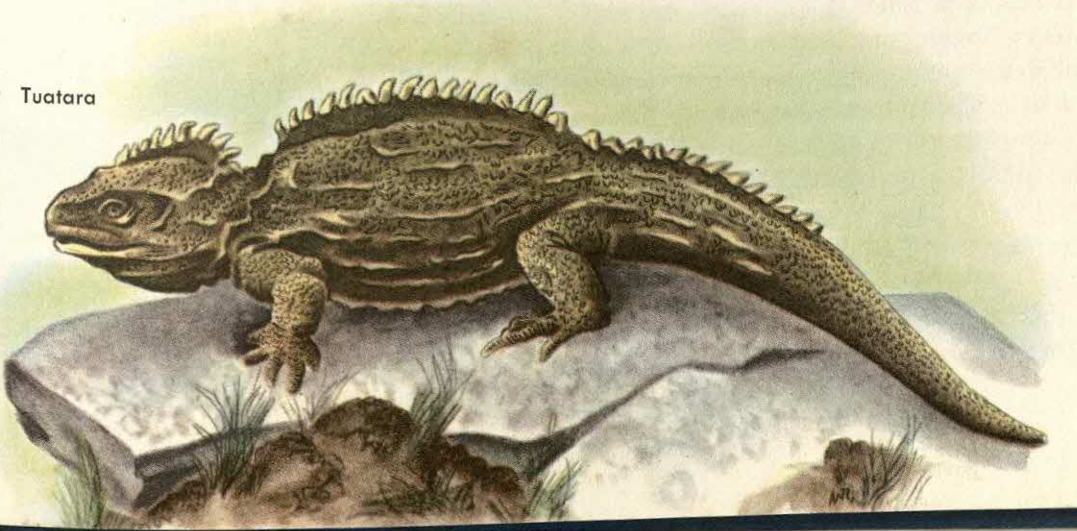


Alligator



Skink, a Lizard

Tuatara



REVERE, PAUL (1735–1818) Among early American silversmiths, Paul Revere ranks high. But probably not many people today would ever hear of him if it had not been for his famous midnight ride.

Revere lived in Boston in the days when the people of the American colonies were beginning to rebel against English rule. He belonged to a group of patriots, the Sons of Liberty, and had been a leader in the Boston Tea Party. This "tea party" was a warning that the colonists would refuse to pay taxes unless they had some share in their own government.

In 1775 there were British troops in Boston ready to enforce the orders of the English king. The colonists, knowing that they might have to fight for their freedom, had ammunition stored at Concord, near Boston. They also had an army of volunteer soldiers called minutemen who went about their regular work but were ready to shoulder their guns at a minute's notice.

The Boston patriots learned that the British were planning to march on Concord and seize the store of ammunition. According to plan the British would go first to nearby Lexington to arrest the patriot leaders Samuel Adams and John Hancock. It was important that these leaders and the minutemen be told as soon as possible when the British started. Of course, there were no telephones or telegraphs or radios then. Paul Revere, a rider, or courier, of the Sons of Liberty, stood ready to carry the word. It came on the night of April 18. And from the steeple of Old North Church in Boston two lanterns flashed the news that the British were setting out by water across the broad Charles River rather than by land down Boston Neck. Through the night Revere rode, rousing the countryside. Near midnight he reached Lexington and wakened Adams and Hancock. Another rider, William Dawes, and Dr. Samuel Prescott joined him, and the three sped off for Concord. When the British reached Lexington and Concord on the 19th the minutemen stood ready for them and the Revolution began.

Revere was a soldier all during the war. Then he went back to Boston and his work. The poet Longfellow told the story of Paul Revere's midnight ride in a stirring poem that almost every American has read. (See BOSTON; U.S. HISTORY.)

RHINE RIVER The picture shows a scene on the famous river Rhine. It is not an unusual scene, for terraced hillsides covered with vineyards stretch for miles along the Middle Rhine. And there are many centuries-old castles on the heights.

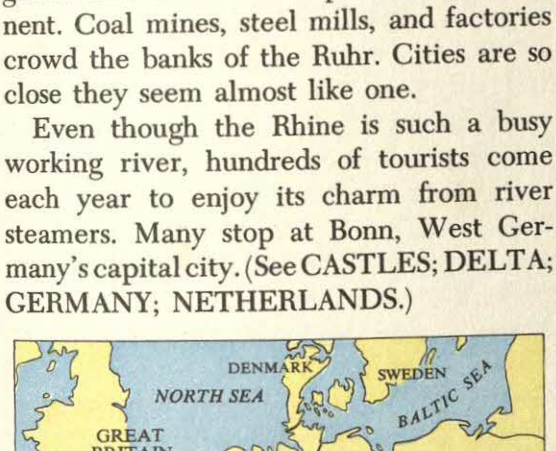
No river has more legends about it than the Rhine. One legend tells of a beautiful maiden, the Lorelei, who was supposed to sit on a rock in the middle of the river, combing her beautiful golden hair and luring sailors to their death. Another legend tells that at Bingen on the Rhine mice once killed a hated bishop. A tower there is called the "Mouse Tower."

The Rhine rises in Switzerland. It flows northward for more than 800 miles into the North Sea. For most of its length it is in Germany or on its border. But where it meets the sea is in the Netherlands.

During the Middle Ages the Rhine was a very busy highway. It still is. No other river in Europe carries so many thousands of tons of cargo. Canals connect it with many other rivers. Barges loaded with coal, iron, oil, and other bulky materials are constantly traveling up and down the Rhine and from it to other parts of Europe.

Rotterdam, Düsseldorf, and Cologne are three of the cities that have grown up on the Lower Rhine. Rotterdam is in the Netherlands. Düsseldorf and Cologne are in Germany. The Ruhr River enters the Rhine just below these two cities at Duisburg, Europe's leading river port. The Ruhr region is one of the busiest parts of the continent. Coal mines, steel mills, and factories crowd the banks of the Ruhr. Cities are so close they seem almost like one.

Even though the Rhine is such a busy working river, hundreds of tourists come each year to enjoy its charm from river steamers. Many stop at Bonn, West Germany's capital city. (See CASTLES; DELTA; GERMANY; NETHERLANDS.)



Black Rhinoceros

RHINOCEROS The name rhinoceros comes from Greek words meaning "nose" and "horn." Every rhinoceros has at least one horn on its nose. Some rhinoceroses, like the kind pictured, have two.

A rhinoceros is a big, thick-skinned animal. Although it is a mammal, it has almost no hair. The eyes of a rhinoceros are small. The animal has poor sight. Its hearing and sense of smell, however, are keen.

Rhinoceroses are found in southern Asia, the East Indies, and Africa. The rhinoceros usually seen in zoos is the Indian rhinoceros. This rhinoceros has heavy folds of skin across its back. It has only one horn, which is about a foot long. For centuries this horn has been used by the Chinese in certain medicines.

The white rhinoceros of Africa, which has two horns, is the largest of the rhinoceroses. Of all land animals only the elephant and the hippopotamus weigh more. The white rhinoceros is really gray, not white. But at a distance it may look almost white because of the dried mud on its body. It often wallows in mud to get relief from mosquitoes and other insects.

The white rhinoceros has bird companions. They are oxpeckers. These birds give warning when danger is near.

If a rhinoceros is disturbed, it usually goes off at a fast trot. To defend itself, however, a rhinoceros may charge head down at its enemy. It is then dangerous.

RHODE ISLAND "Little Rhody" is the smallest state in the United States. It is one of the oldest states, too, for it was one of the 13 colonies that became the first 13 states. In 1936 Rhode Islanders celebrated the 300th anniversary of the founding of Providence, the first settlement in that colony. Today Providence is the state's capital and largest city.

Tiny Rhode Island is tucked in between Connecticut to the west and Massachusetts to the north and east. It is bordered on the south by the Atlantic. As the map shows, a long arm of the Atlantic called Narragansett Bay is in the eastern part of the state. The Sakonnet "River" farther east is another arm of the sea.

Rhode Island is the name of the largest island in Narragansett Bay. Another name for it is Aquidneck. The name Rhode Island is only a part of the state's whole name. Its whole name, which is on the state seal, is so long that it is hardly ever used. It is State of Rhode Island and Providence Plantations. Providence Plantations is a name given long ago to the mainland of the colony. Both islands and mainland make up this smallest of the states with the longest of the state names. From 1854 until 1901 Rhode Island had two capitals—Providence on the mainland and Newport on Rhode Island.

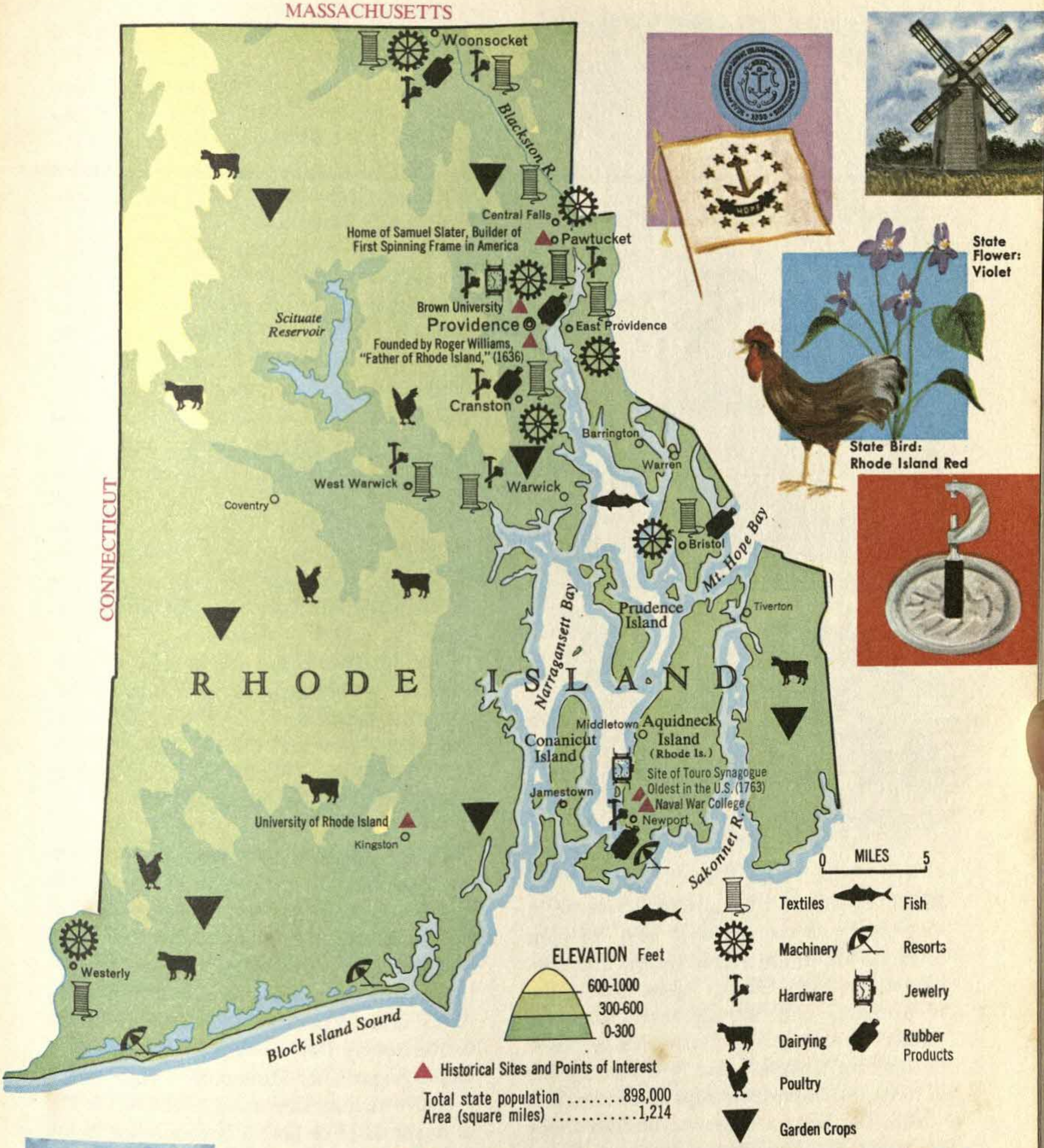
One of the most famous of the early settlers was Roger Williams. He and a band of followers had been banished from Massachusetts because they complained about not having enough freedom there. He paid the Indians for land. At first the settlers depended chiefly on fishing and the few crops they could raise. But before the American Revolution Rhode Island had 350 trading vessels sailing all along the coast from Newfoundland to Georgia. Some went on to the West Indies, and to Africa and other distant lands. Many whaling vessels, too, used to set out from Rhode Island ports. Today the chief harvest Rhode Islanders get from the sea is shellfish.

In 1790 Samuel Slater, a factory worker from England, built at Pawtucket the first power machinery in America for spinning cotton yarn. Cotton mills and mill towns sprang up where falls in rivers furnished power. The first power loom in the United States, set up over 150 years ago, was in Rhode Island. Textiles are still important among Rhode Island's factory products. Other important ones are precision tools, machinery, jewelry and silverware, and rubber and plastic goods. Electronics is a growing industry. Providence, Pawtucket, Cranston, Warwick, and Woonsocket are the largest manufacturing cities. Over four-fifths of all Rhode Islanders live in cities or towns. In the past 125 years thousands from French Canada, Great Britain, and Ireland, as well as from Italy and other parts of the European continent have come to find work in Rhode Island.

Fewer than 2 out of every 100 workers in the state are farmers. They produce food city people want to have fresh—eggs, dairy products, vegetables, and chickens. Rhode Island Red poultry is famous.

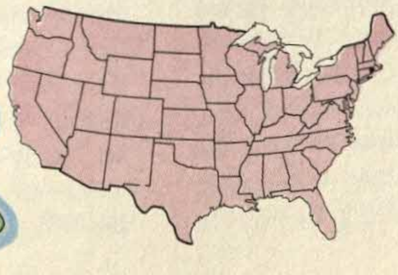
There are more people in Rhode Island than there are in each of 11 larger states. But, in spite of its many crowded areas, there are handsome colonial and modern homes, acres of forest land, and many beauty spots, lovely beaches, and vacation resorts. The city of Newport has long been a popular resort. At Newport, too, is the Naval War College. The famous yacht races for the America's Cup, held off Newport, bring many visitors to Rhode Island. So does Newport's annual jazz festival.

It is not clear how the island of Rhode Island got its name. Perhaps the Dutch named it Red Island, and "Rhode" came from their word for "red." Perhaps, instead, it was given its name by an Italian explorer who was naming it for the Greek island of Rhodes, the name of which is *Rodi* in Italian. In any case, Rhode Islanders have chosen the red maple as their state tree. Their song is "Rhode Island."

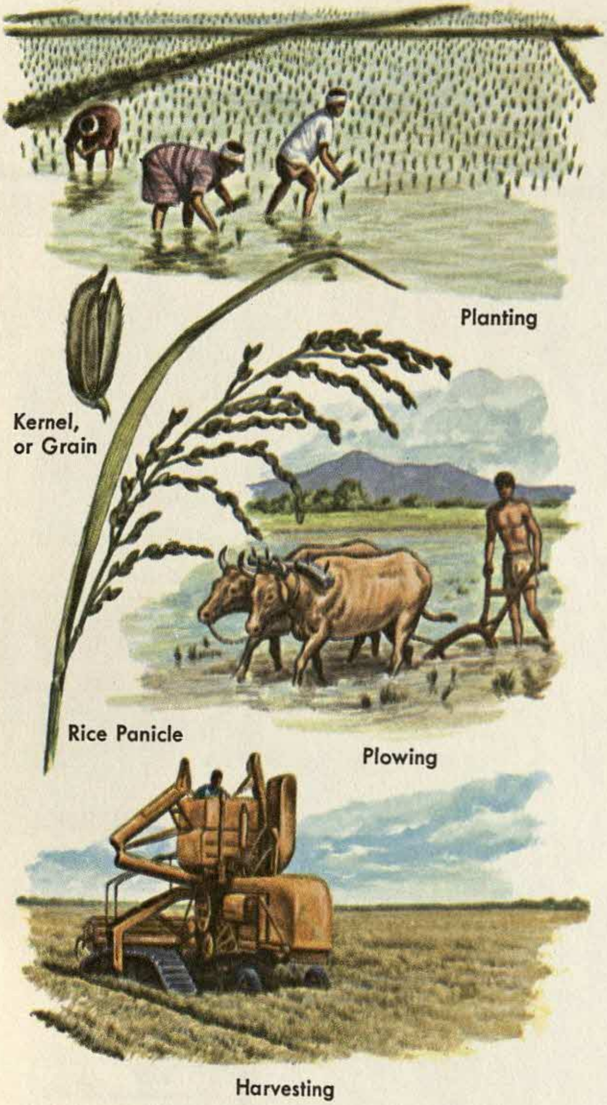


Total state population 898,000
Area (square miles) 1,214

Newport Mansion



Yacht Race



RICE Fields of rice are as common in some parts of the world as fields of corn or wheat are in the United States. The people of southern China, Japan, India, the Philippines, and southeastern Asia live chiefly on this cereal. Some rice is raised in southern United States, but it is not one of the more important crops of the country.

Rice has been a common food for many centuries. We know that it has been raised in some places for 5,000 years.

A field of rice ready for harvest looks from a distance much like a field of ripe wheat. It is not surprising that it does, for rice and wheat are rather close relatives. They both belong to the big family of grasses, the plant family that gives us our cereal grains.

Rice needs more warmth and much more water than most grain crops. Most rice fields are kept flooded a large part of the time while the rice is growing. The flooded fields are drained when the rice is about ready to be harvested.

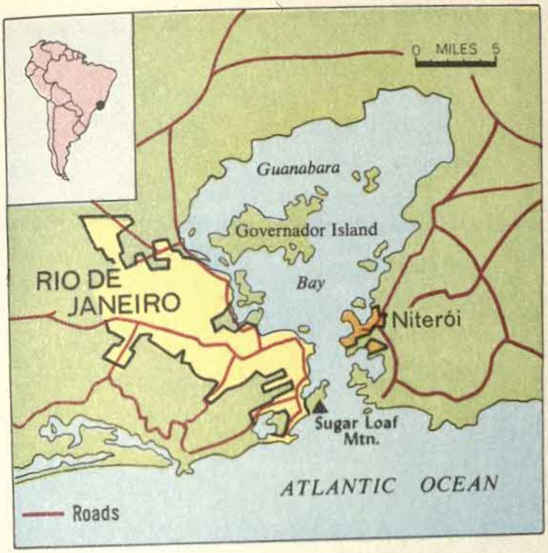
Rice grains are mostly starch. Some rice is made into flour. Rice flour is not good for making loaves of bread. But it is often used for making thin cakes a little like crackers. Most rice is boiled and eaten with a meal much as potatoes are eaten.

The white rice we buy in grocery stores has been polished—the brown hull of the grain has been taken off. Polished rice is not nearly as good for us as unpolished rice, for the hull has vitamins and minerals in it. If the people who live mostly on rice eat polished rice, they are likely to have the disease called beriberi. This disease is caused by a lack of vitamin B_1.

The Japanese drink called sake is made from rice. Other peoples make other drinks from this grain. Rice straw can be woven into hats, shoes, and matting. (See CEREALS; FLOUR; FLOWER FAMILIES; FOODS; GRASSES; VITAMINS.)

RIO DE JANEIRO Whether approaching by ship or air, visitors to Rio de Janeiro are struck by the great beauty of this famous city of Brazil. Mountains look down like giants at a toy town. Tropical vegetation covers the mountains almost to the top. A tall granite peak rises near the entrance to the roomy bay which Rio borders. It is called Sugar Loaf Mountain.

Many visitors ride a cable car to the top of Sugar Loaf or take a cog railroad to the top of another even higher peak nearby, the Corcovado. From these high points they see how Rio fits into its gorgeous setting. Following the shoreline for miles are sandy beaches. Long rows of tall apartment buildings, hotels, and fine homes line the broad highway near the shore.



Beach Scene

"Christ the Redeemer"

Skyscrapers

Bay

Expressway

The Corcovado marks the end of the Carioca Mountains, from which the people of Rio get their name—the Cariocas. From its top the towering "Christ the Redeemer" seems to watch over the city.

It is several miles from the entrance of the bay to the docks of this busy seaport. A huge airport is on level land at the waterfront here. A mountain was cut down and millions of tons of rock dumped into the bay to make land for the airport. Not far away are the tall buildings of the city's modern business district.

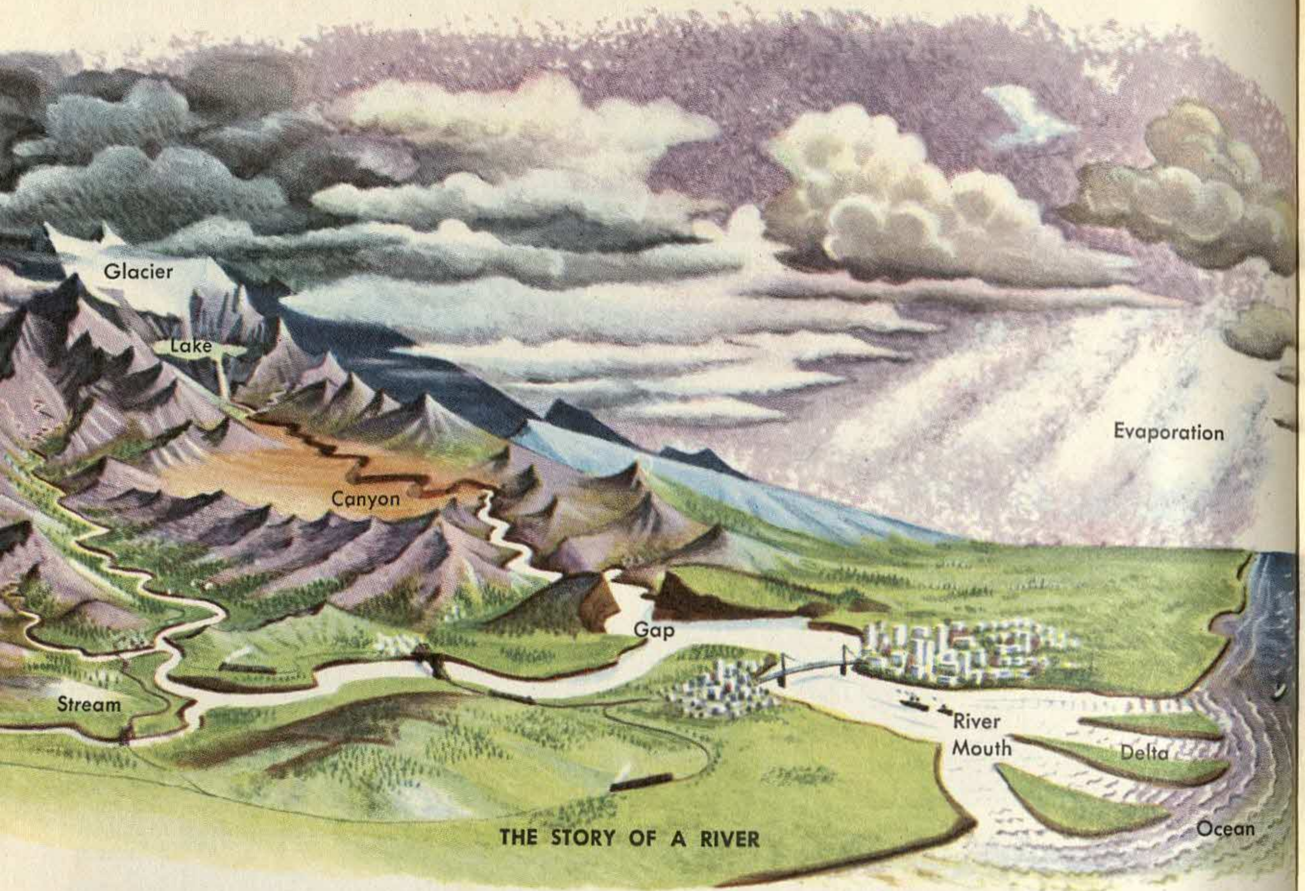
Except for the downtown district Rio does not spread out. Instead it reaches long arms up narrow valleys and into the mountains. Tunnels bored through the mountains in places make it easier for people to get from one section of the city to another.

Among Rio's many fine avenues is the Avenida Rio Branco, a broad thoroughfare along which the big parade of Rio's famous Carnival moves. The Carnival is held the last four days before Lent each year. It is a time of fun for everyone. Grown-ups and children alike dress up in gay costumes. Clowns, goblins, pirates, and pixies all join together in the songs and dances.

Many kinds of work keep the Cariocas busy. Wholesale houses, transportation terminals, assembly plants, and factories need many workers. Rio is a good place for factories. Mountain streams drive big power plants to give electricity for the factories. Railways, airways, and highways connect the city with its backcountry. Metal goods, furniture, and cloth are among the things Rio's factories make. For nearly 200 years before Brazil's made-to-order capital city of Brasília took over as the seat of government in 1960, Rio was Brazil's capital. A fine new highway links the two cities.

It is more than 400 years since some Portuguese explorers sailed into the bay on a summer New Year's Day. They thought they had reached the mouth of a large river and named it River of January. The city took that name. Today it has more than 4,000,000 people. (See BRAZIL.)

STATE INSTITUTE OF EDUCATION
Bengal



THE STORY OF A RIVER

RIVERS In a steep cliff on the edge of the sea a tiny gully starts. After a rain, water rushes down the gully into the sea. The water rushing down wears the gully deeper. Little by little water running into it at its head makes the gully longer, too.

As the gully gets deeper and longer, it also gets wider. It swallows up other gullies nearby. At last it gets so wide and so long and so deep that it has water in it all the time. It is now the valley of a little stream.

The stream slowly grows large enough to be called a river. The young river eats its way farther and farther back into the land. Little gullies on its banks grow into stream valleys. Their streams become branches of the river. The river gradually makes its valley wider. At first its valley is shaped like a capital V. Now it begins to have a flat floor. The river becomes middle-aged. It is many miles long.

The river now cuts sideways faster than it cuts down. Its valley becomes very wide. The river wanders back and forth over it, flowing slowly. It is now an old river.

This story is the story of most rivers. A river is young, then middle-aged, then old. Its valley tells its age. Strangely enough, a young river may be many times as old in years as an old river. For example, a river that is cutting its way through soft rock or soil grows old much faster than a river that is cutting through very hard rock. The Colorado River, which flows through the Grand Canyon, has been flowing on its way for millions of years, but it is still young. Over most of its length its valley is still V-shaped.

No one in his lifetime sees a river "grow up." The great rivers of the world have been thousands of years in the making.

Rivers have always been highways. Probably people floated down them on rafts made of logs even before they knew how to make boats. There were river highways long before there were good roads, and even longer before there were railroads. In some parts of the world the best way of traveling is still on the rivers. In fact, many of the world's largest cities are on rivers. Some of these cities are built where a river meets the sea.

A river is always at work. It may carry logs down mountainsides or turn wheels that drive machines. It may carry wastes away from cities. Its current may help move rafts and barges.

But even if a river is not doing any work for people, it is always doing work of its own. It carries loads of soil toward the sea. Water that runs over fields on the way to a stream picks up soil and carries it along to the stream. Besides, the river is always wearing away its banks. Every year rivers dump millions of tons of soil into the sea.

Rivers build new land, too. They build new land by dropping the loads they are carrying when they reach the sea.

But rivers wear away land much faster than they build new land. If rivers were the only forces at work to change the face of the earth, all the land would sooner or later be worn down to the level of the sea.

Some of the world's rivers are thousands of miles long. It is hard to tell exactly how long a river is. A river usually turns and twists. Or it may broaden out into a lake in some places. Should the lake be counted in the length of the river? It is sometimes hard to tell, too, which is the main river and which is a branch. It is easy to see, then, why different books may give different lengths for the same river.

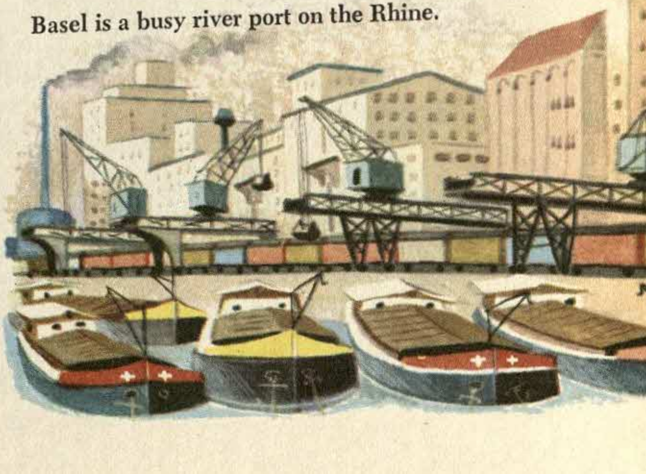
The Mississippi River is one of the world's great rivers. It flows from northern Minnesota into the Gulf of Mexico. The Missouri River is one of its branches. The Missouri joins the Mississippi near St. Louis. The Missouri measures much longer than the Mississippi from the mouth of the Missouri northward. The Mississippi from the Gulf to the mouth of the Missouri plus the Missouri is one of the three longest rivers in the world.

The Seine flows through the center of Paris, France.

The chart below shows 15 of the world's great rivers. All of them, as you see, are over 2,000 miles long.

RIVER	FLOWS INTO	LOCATION	LENGTH IN MILES
Nile	Mediterranean	Eastern Africa	4,150
Amazon	Atlantic Ocean	Brazil	3,900
Mississippi-Missouri	Gulf of Mexico	United States	3,860
Ob-Irtysh	Gulf of Ob (Arctic)	U.S.S.R. (Asia)	3,460
Yangtze	East China Sea	China	3,430
Congo	Atlantic Ocean	Central Africa	2,900
Hwang Ho	Yellow Sea	China	2,900
Amur-Kerulen	Sea of Okhotsk (Pacific)	U.S.S.R.-China	2,800
Paraná-LaPlata	Atlantic Ocean	Brazil-Argentina	2,720
Lena	Arctic Ocean	U.S.S.R. (Asia)	2,650
Mekong	South China Sea	China-Southeast Asia	2,600
Niger	Gulf of Guinea (Atlantic)	Western Africa	2,600
Yenisei	Arctic Ocean	U.S.S.R. (Asia)	2,560
Mackenzie	Beaufort Sea (Arctic)	Canada	2,525
Volga	Caspian Sea	U.S.S.R. (Europe)	2,325

Basel is a busy river port on the Rhine.



Old Roman Road

ROADS AND STREETS The story of roads begins far back in the days when traveling by foot was the only way of traveling on land. The very first roads were footpaths. Probably people simply took over trails made by wild animals. There are still places where roads are merely footpaths. There are still streets—roads through towns and cities—that are wide enough only for people on foot.

After horses and donkeys were tamed, roads had to be wide enough for riders to pass. Later they had to be wide enough for carts and chariots. In time coaches and big wagons called for still wider roads. In recent years automobiles, buses, and trucks have made the need for wide highways far greater than ever before.

A great many of today's roads and streets are paved. The idea of paving highways is not new. More than 3,000 years ago Babylonia, Egypt, and Crete had some paved highways. But the Romans were the first great builders of paved roads.

Much was learned about the streets of ancient Roman cities when the ruins of the little city of Pompeii were uncovered. The streets there are paved with blocks of stone. At the sides there are raised walks for people on foot, and now and then there are raised stepping-stones across the streets. Visitors to Pompeii can see clearly that these Roman streets were planned more for people on foot than for wheeled vehicles.

It is easy to see what Roman roads outside the cities were like, for some of them are still in use. The famous Appian Way is one. The Romans made roads chiefly so that they could move their troops fast.

In the Middle Ages, just as in the days of Rome, most of the wheeled traffic was on the roads outside the cities. Almost the only travel inside the medieval cities of Europe was on foot or on horseback. Many of the streets were just narrow passageways between the houses. There were seldom any sidewalks along them.

During the Middle Ages almost no paved roads were built. Roads were so poor even in the 17th century that journeying by horseback was likely to be safer and more comfortable than journeying in a wheeled vehicle. There is a record of a French traveler whose coach was stuck in the mud so often that it took him three full days to travel 20 miles. No wonder most people never traveled far from home!

As trade between cities increased, more attention was paid to streets and roads. Paved highways were built again.

Many different ideas for paving streets and roads have been used. In the early days of the United States, for example, road builders paved roads by laying trunks of trees side by side across the roads. Roads paved in this way were called corduroy roads. It is easy to imagine how bumpy a ride on a corduroy road must have been. The roads of ancient Rome were paved with slabs of stone lying on beds of crushed stone or gravel. Brick, cobblestones, wooden blocks and planks, and asphalt are other materials that have been used.

Good modern road building began about 1800. Then two Englishmen, Thomas Telford and John MacAdam, began building roads of crushed stone. Later asphalt or coal tar was added to make macadam roads. The chief road-building materials today are concrete and asphalt mixtures. There are now almost 3,000,000 miles of paved highway in the United States alone.

Huge sums of money are spent on our streets and roads. Old highways are repaved and wonderful new expressways are built. Some run right through mountains, over and under rivers and railroads, or across swamps, lakes, and stretches of ocean. In road building today special attention is paid to highway intersections.

Good roads are so expensive that some roads are being made to pay for themselves through tolls. Every person who travels on such a road must pay a toll, or fee. Roads that are not toll roads are built and kept up through taxes.

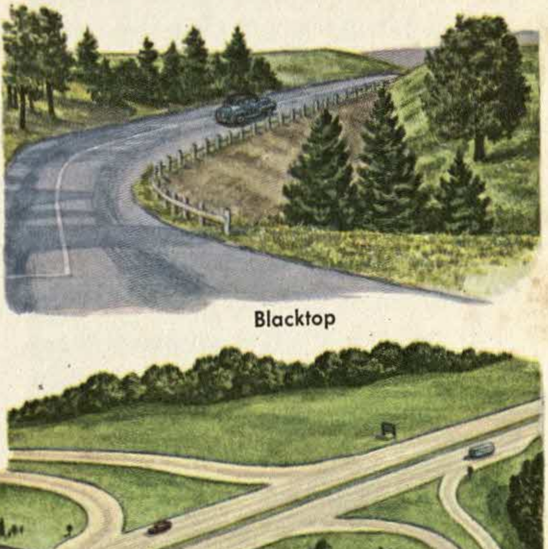
Almost as long as there have been roads, some rules of the road have been needed. Suppose, several thousand years ago, two travelers met on a narrow footpath. Should one move aside and let the other have the whole road? Or should each one move aside a little? Gradually customs grew up, and rules of the road grew out of the customs. In the United States, for instance, it is the rule that on a two-way road or street, one keeps to the right.

Perhaps the right-hand custom came about when people drove oxen along the roads. Oxen were often driven by a person walking beside them at the left. It was therefore more convenient for the driver to move his oxen to the right when he met someone. Even if the oxen had to get off the road, the driver could stay on it.

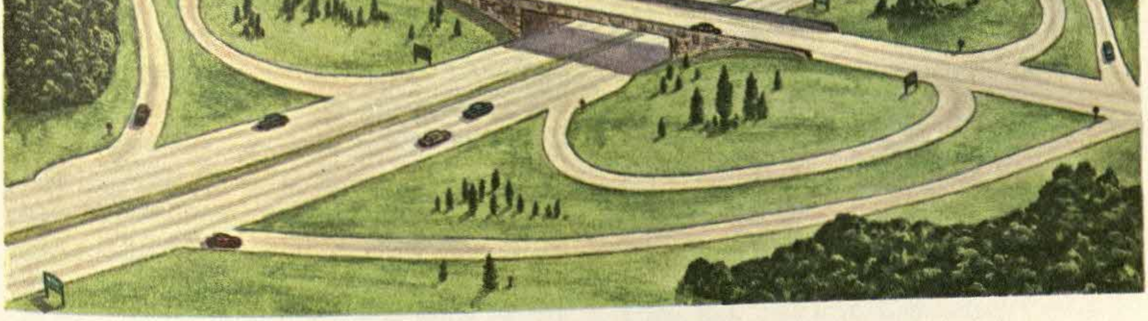
In England the opposite rule is followed. Traffic keeps to the left. Perhaps this custom

Dirt Road

Gravel Road



Blacktop



Cloverleaf, Modern Expressway

came about when men carried swords as they rode horseback. If a rider was on the left side of the road, his sword arm was toward the approaching traveler.

Today there are many traffic rules. Some of them had to be made in a hurry as automobiles began to crowd the highways. There was no chance to wait till rules could grow up from customs. Signals of many kinds have been devised to help control traffic. There are also traffic police to see that the rules are obeyed. In the United States a person must prove that he knows the rules of the road in order to get a license to drive a car. But still there are many highway accidents. Now that we have wonderful roads, we have the problem of making them safe.

ROBIN Over much of the United States the robin is likely to be the first songbird children know by name. It lives in almost all parts of the country. It seems to like to be near people. It is big enough to be seen easily. And it hops about in plain view when it is hunting for food.

In the southern states the robin can be found the year round. Most of the robins from the northern states go south for the winter. They come back early in the spring. The sight of a robin is usually one of the first signs of spring.

This bird got its name by mistake. When the early settlers saw it, it reminded them of the robin redbreast they had known in the Old World. So they called it a robin. The two birds do look much alike, but the American robin is larger. Both belong to the big family of thrushes, which also includes the hermit thrush and the bluebird.

The robin builds a very sturdy nest. It is made of sticks, leaves, and grass cemented together with mud. The nest is often close to a house. It may even be on a porch. The mother robin lays from three to five beautiful blue eggs in the nest. The baby robins that hatch from them are almost naked and are very helpless. They have big appetites. Finding worms and insects for them keeps the parent birds busy. In about ten days the young robins are covered with feathers. But they do not yet look much like grown-up robins. They have speckled breasts that remind us that they are cousins of the hermit and wood thrushes.

Robins, like people, eat both plant and animal food. Fruitgrowers often complain because robins eat some of their fruit. But robins pay for the fruit they eat by eating harmful insects. (See BIRDS.)

ROBIN HOOD There was a great archery tournament in Nottinghamshire. The sheriff of Nottingham had offered an arrow of pure gold to the winner of the match. The sheriff hoped that one of those who came would be Robin Hood. For there was a reward of 200 pounds for Robin Hood and the sheriff was eager to capture him.

The most famous archers from all the surrounding country were at the match. But there was no one dressed in Lincoln green, the color Robin Hood always wore. "He is a coward," the sheriff said to himself, "and was afraid to come."

The shooting began. At last only three men were left in the match. One was Gil o' the Red Cap, and another was Adam o' the Dell. These two men were well known to the people watching them. The third was a stranger who had a patch over one eye and wore a tattered red suit.

Each of the three shot an arrow. All three arrows were near the center, but closest of

In Sherwood Forest

all was the stranger's. Then Gil o' the Red Cap shot again. His shot was so good that the crowd gasped. They were sure that he had won the prize. But up the stranger stepped. His arrow flew straight to the center of the target. No one could hope to do as well as the man in red. The sheriff gave the stranger the arrow of gold.

That night the sheriff gave a big dinner. In the middle of the dinner an arrow flew in through a window and landed on the table. On its tip there was a note. "Today you gave the prize," it said, "to Robin Hood." The stranger in the tattered red suit had been Robin Hood.

This is one of a great many stories about Robin Hood. He lived, the stories say, in Sherwood Forest more than 700 years ago. He had a merry band of men who, too, always wore suits of Lincoln green.

Robin and his men were all outlaws. They were hiding, that is, because they had broken a law of some kind. Many of them had done nothing worse than kill a deer that belonged to the king. Little John, Will Scarlet, Allan a Dale, and Midge, the Miller's son, were four members of the band. Friar Tuck was the chaplain.

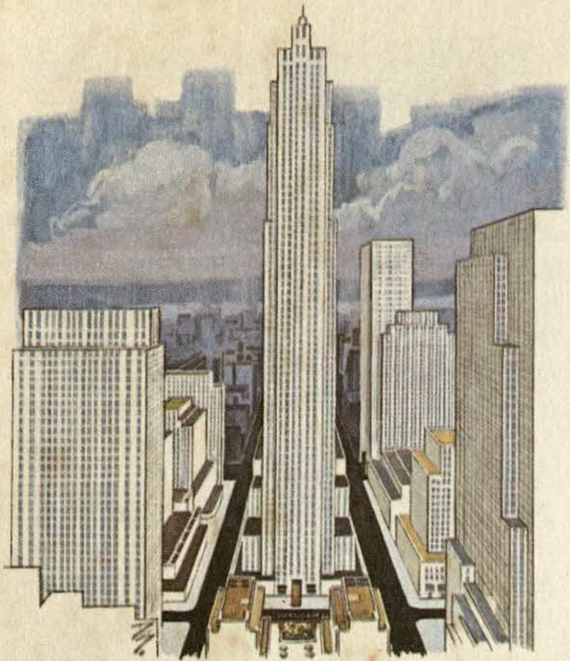
The band was loved by all the country folk. For it stole from the rich to help the poor. No poor man asked in vain for help from Robin Hood. And all the while Robin and his band of men lived a happy life in the forest and had many adventures.

Robin Hood probably was not a real person. The stories about him are thought to be just made-up stories. But they at least show what kind of person would have been a hero in England in the Middle Ages.

Long after the time of the Robin Hood stories, it began to be told that Robin Hood had finally been pardoned by King Richard the Lion-Hearted and made an earl. There is even a tombstone which tells that under it lies the Earl of Huntingdon, once called Robin Hood. But scholars say that there is no truth to this story. The tombstone is not 700 years old. It was made, they say, to try to make people believe the story. (See ARCHERY; MIDDLE AGES; MYTHS AND LEGENDS.)

ROCKEFELLER CENTER "A city within a city" Rockefeller Center has been called. Its 18 buildings cover 17 acres in the heart of New York City. In it close to 50,000 people work. More than 1,400 firms have offices there. There are over two dozen eating places, a post office, and a 700-car garage. Radio City Music Hall in the Center is the largest indoor theater in the world. There are shops of many kinds, broadcasting studios, and big exhibition halls. The consuls of 20 foreign countries have their offices in the buildings. There are acres of roof gardens, and in winter there is an outdoor skating rink. More than 160,000 people visit the Center on an average day. The tallest building in the group is the 70-story RCA Building. The Observation Roof on the 70th floor is 850 feet above the street. It provides a wonderful view of New York City.

The group of buildings gets its name because it was built by John D. Rockefeller, Jr. The first building in it was started in July of 1931. Altogether the Center has cost well over a hundred million dollars. New buildings are added from time to time. The Time and Life Building was completed in 1959. It was the first one not Rockefeller property in the Center. In 1963 the Sinclair Oil Building, opened in 1952, was



Rockefeller Center

bought and made part of the Center. Other additions are under construction.

The buildings have straight lines and little decoration. Usefulness rather than beauty was the first consideration in their design. Even so, much has been done to make them beautiful. The straight lines of the buildings are pleasing. So is the pale tan stone many of them are made of. Besides, there are murals and bronze figures and other inside decorations. The famous Prometheus Fountain is in the Plaza, a private street through the Center.

Much of the land on which Rockefeller Center is built belongs to Columbia University. The rent for that land, under lease until 2069 and renewable at that time, is $3,800,000 a year. (See FOUNTAIN; NEW YORK CITY; SKYSCRAPER.)

ROCKETS In a fireworks display on the Fourth of July there are almost sure to be some skyrockets. With a loud swish a skyrocket goes into the air. High above the ground the head of the rocket bursts into bright-colored stars. The chief part of a skyrocket is a heavy paper tube, open at one end. It is filled with a powder to burn and a chemical to furnish the oxygen needed for burning. Hot gas from the burning powder shoots out of the tube. As it does, the rocket is pushed in the opposite direction, high into the air. A special powder in the head of the rocket is then set on fire. It produces the fireworks.

The Chinese had rockets much like our skyrockets more than 700 years ago. But these rockets were not fireworks but weapons to be fired at an enemy.

The idea of using rockets as weapons spread far and wide from China. As the centuries went by, rockets were made bigger. Metal cases took the place of the paper cases. The head was made so that it would explode when it struck anything. But for a long, long time rockets were not a great success. One line in "The Star-Spangled Banner" mentions "the rockets' red glare." In the War of 1812 the British did not capture Fort McHenry in spite of the rockets they were shooting at it while Francis Scott Key wrote the song.

The story was quite different in World War II. In that war rockets were very important weapons. The famous V-2 rockets did extensive damage to English cities when they were fired across the English Channel by the Germans. The V-2's were huge rockets that weighed several tons.

The fuel of the V-2's was alcohol. Liquid oxygen furnished the oxygen needed. Oxygen is usually a gas but can be changed to a liquid by cooling. The fuel worked so well that it sent the V-2's 70 miles above the ground and clear across the Channel. They traveled a mile a second.

Although the V-2's were German weapons, the Germans did not make the first liquid-fuel rockets. The first were made by Robert Hutchings Goddard, an American. Goddard was the first great rocket scientist. It was Goddard who designed the first rocket with more than one stage, or step.

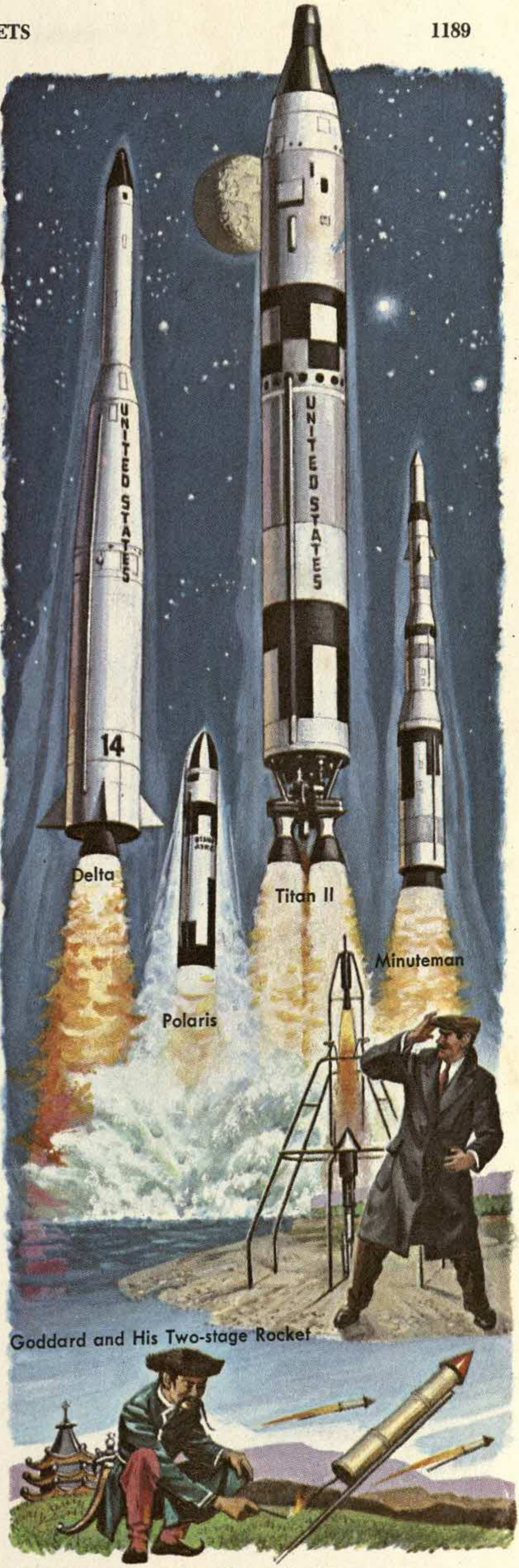
In a rocket with more than one stage, the fuel in the bottom stage burns first. It sends the rocket high into the air. When its fuel is used up, this section drops off.

The fuel in the second section now starts to burn. It gives the rocket another push. If there is a third stage, the second stage drops off when its fuel is used up, the fuel in the third stage begins burning, and so on. A rocket's fuel and its source of oxygen are called its propellants. The different stages of a multistage rocket may use different propellants.

Since World War II many rockets have been built by the United States and other countries. They have been built not only to serve as weapons but also to explore the upper atmosphere and to launch space vehicles. A rocket may serve more than one purpose. The Scout, for instance, is a four-stage rocket that has been used both to study conditions high above the ground and to put small unmanned satellites into orbit. Of the four modern rockets in the picture, two—Polaris and Minuteman—are weapons, or missiles. The other two—Delta and Titan —are launch vehicles. Titan, however, can be used as a missile.

The rockets built as weapons are in four classes: surface-to-surface, surface-to-air, air-to-air, and air-to-surface. Surface-to surface missiles take off from on or under the earth's surface and hit targets on land or sea or underwater. Surface-to-air missiles take off from the ground and hit airplanes or other targets in the air. Air-to-air missiles are launched from one aircraft toward another. Air-to-surface missiles are fired from the air at targets on land or sea. Different missiles have different guidance systems to guide them to their targets. They all carry warheads.

Minuteman and Polaris are both surface-to-surface missiles. Minuteman is an intercontinental ballistic missile (ICBM). It can be guided to a target more than 6,000 miles away. This 60-foot rocket has three stages. Since all three use solid propellants, the Minuteman can be stored underground for long periods and still be ready to fire at a moment's notice. Polaris, 32 feet tall, has only two stages and burns



Early Chinese Rocket

solid fuel in both. It is fired from nuclear-powered submarines. The newest Polaris missiles have a range of 2,900 miles.

Among the surface-to-air missiles the United States has developed are Talos, Hawk, and Terrier. Hound Dog and Bullpup are examples of air-to-surface missiles. Sidewinder is in the air-to-air group.

Rockets for studying the upper atmosphere are often called sounding rockets. Aerobee and Honest John are among the U.S. rockets developed in this group.

The most exciting rockets are those that launch space vehicles. Delta, a 90-foot-tall, three-stage rocket, is one of the workhorses of the space program. It has launched many unmanned satellites. The propellants of the first and second stages are liquid, that of the third stage solid. Titan II rockets launched all the Gemini manned satellites on their very successful trips. Titan II is a two-stage rocket. Both stages use liquid propellants. The picture shows a Titan with a Gemini capsule as its payload.

The Mercury capsule that carried the first U.S. astronaut into space was launched by a Redstone rocket. But the four Mercury capsules that orbited the earth were launched by Atlas rockets.

Apollo spacecraft are launched by Saturn rockets. Saturn V, with its Apollo payload, is 365 feet high. When fueled it weighs over six million pounds. This giant rocket is pictured on page 113 in Volume 2.

Saturn V has three stages. The propellants of the first stage are kerosene and liquid oxygen (LOX). They are used up at the rate of over 15 tons per second! The propellants of the second and third stages are liquid hydrogen and LOX. Saturn V has some 300,000 parts that must work perfectly for a successful launching. In December of 1968 this giant rocket sent three American astronauts to the moon in Apollo 8. The journey was the first ever made by man beyond the pull of the earth's gravity. (See ASTRONAUTS; SATELLITES: SPACE TRAVEL; WEAPONS.)

ROCKS The crust of the earth is made mostly of solid rock. No matter where a person is on the earth, there is solid rock, or bedrock, beneath him. The rock may be covered with a deep layer of soil. It may be covered with several feet or even several miles of water. But a hole dug far enough below the surface anywhere on earth would reach bedrock.

There are a great many kinds of rock in the earth's crust. It takes years of studying to tell the many kinds apart and to know their stories. But they can all be divided into three big groups. The groups have rather hard names: igneous rocks, sedimentary rocks, and metamorphic rocks.

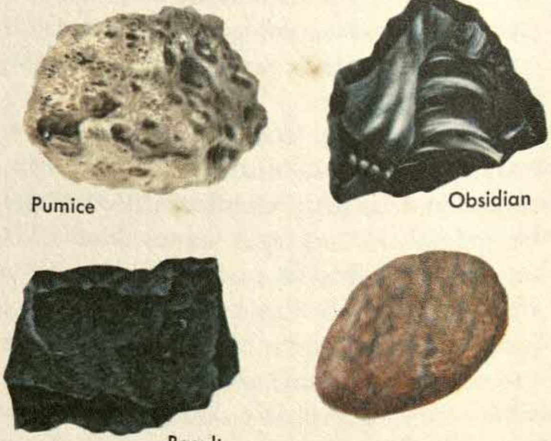
"Igneous" comes from a word meaning "fire." All igneous rocks are made from rock so hot that it is liquid. Some are formed from hot, liquid rock that pours out of a volcano. We call such rock *lava*. Some igneous rocks are formed instead by the cooling and hardening of hot, liquid rock, or *magma*, below the surface of the ground.

The first rocks formed in the earth's crust were igneous rocks. Igneous rocks are still being formed today.

The picture on this page shows four common igneous rocks. These rocks can be told from one another quite easily.

Obsidian is often called volcanic glass. It looks very much like black glass. This rock is pretty, but very few things are made of

IGNEOUS ROCKS

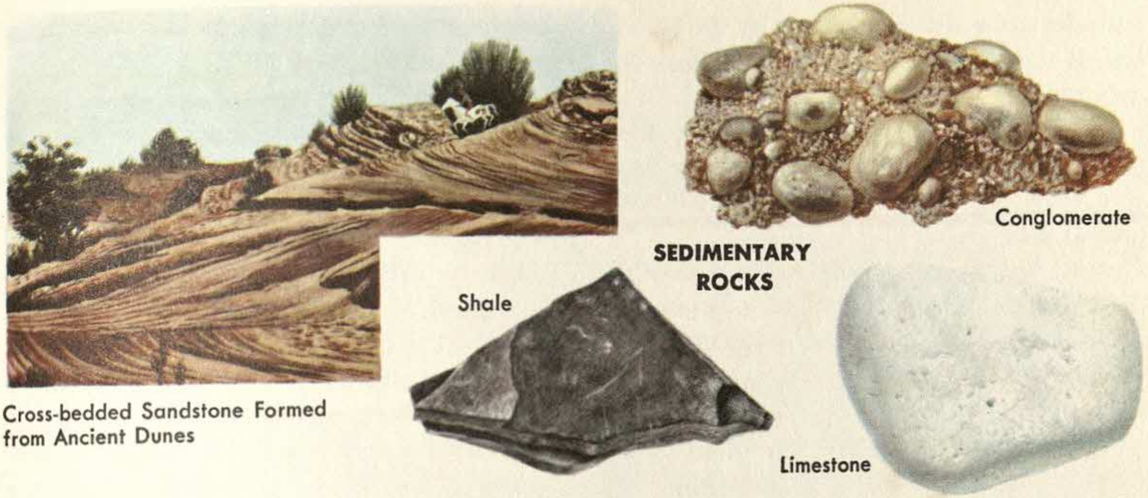


Pumice

Obsidian

Basalt

Granite



Cross-bedded Sandstone Formed from Ancient Dunes

SEDIMENTARY ROCKS

Conglomerate

Shale

Limestone

it. It breaks in a peculiar way when anyone tries to carve it. Obsidian comes from lava that cools fast.

Basalt is black, but it is not shiny like obsidian. It comes from lava that cools slowly. When basalt cools, it sometimes breaks up into six-sided columns. People of long ago were puzzled by these columns that looked as if they had been carved.

Pumice is so light that it will float on water. As lava pours out of a volcano, the top part cools so fast that it gets frothy. The froth hardens into pumice.

Granite is never made from lava that pours out on the ground. Instead, it is made from magma. It cools very slowly. Granite is a beautiful rock. It can be polished easily. It is always speckled, for it always has crystals of three different kinds in it: feldspar, quartz, and black mica or some other dark mineral. Some feldspar is white, and some is pink. So we have gray granites and red granites.

Diorite is another rock that is made from magma instead of lava. It is speckled like granite but has many more black crystals in it and fewer light-colored ones.

Tiny bits of lava are sometimes shot high in the air when a volcano erupts. They become dust and ash. After they settle they pack together and harden into tuff. Tuff looks like hardened ashes from a furnace with bits of cinder mixed in.

Rivers are always carrying pebbles and sand and mud down to lakes and seas. Waves wash them out from shores, too. The pebbles and sand and mud fall to the bottom of the water. They form layers there. Small animals with shells live in lakes and seas. They die, and their shells fall to the bottom of the water. There may be so many that they form a thick layer.

Little by little the particles of sand and mud, the pebbles, and the shells are cemented together by lime or some other material. They become layers of rock. The rocks formed in this way are called sedimentary rocks. "Sedimentary" comes from a word which means "settle," or "sink down."

The surface of the earth is always changing. Many parts of it that were once covered with water are dry land now. In some of these places there are layers and layers of water-made rocks. When a river cuts down through these rocks, the layers show like the layers of a giant cake that has had a big piece cut out of it.

Some sedimentary rocks are not made entirely by water. Wind and ice as well as water can carry and drop the sand, mud, and pebbles out of which some of these rocks are made.

The four sedimentary rocks in the pictures on this page are all common. Shale is the most common.

Shale is made of mud. Some shale is red. Some is gray. Some is green. Some is black. Shale is a smooth rock, but it is not very hard. When it is wet it smells like mud.

Sandstone is made of sand, as its name tells. It may be gray, red, yellow, brown, or greenish. The grains of sand can be felt in a piece of sandstone. In some sandstone the grains of sand are not cemented together very well. Such sandstone crumbles into sand easily.

Conglomerate is made of pebbles. The pebbles are easy to see. There may be many different kinds of pebbles in conglomerate. For this reason it is sometimes called "pudding stone."

Shells are made mostly of lime. The rock made from shells is called limestone. In some limestone, shells can be seen clearly. Limestone is also made in the sea by tiny animals called corals. Corals do not have shells, but they do build "houses" out of the lime in the water. These houses are made of a limestone called coral limestone. Some limestone is made from lime that comes from the water itself and simply settles to the bottom. Most limestone, no matter how it is made, is white, cream-colored, or gray. But there are brown and even black limestones. Many beautiful buildings are built of this common sedimentary rock. Very soft limestone is called chalk.

Coal is also one of the sedimentary rocks, but it is very different from the others. It was made from forests that grew in the swamps of long ago. As the trees died, they fell into the water and were covered by mud. Little by little they were changed to coal. One kind of coal is called soft coal even though it is not at all soft.

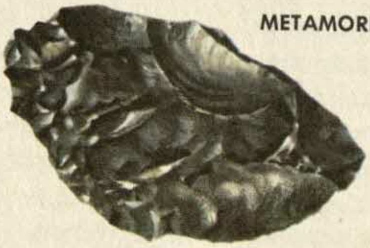
As the earth's surface changes, layers of rock are often greatly squeezed and pushed. They are often heated to a very high temperature, too, by the heat from deep in the earth and from hot, liquid rock that flows near them. Great heat and pressure may change one kind of rock into another kind. These changed rocks are the metamorphic rocks. "Metamorphic" comes from a word that means "change." Every metamorphic rock was first a sedimentary rock or an igneous rock.

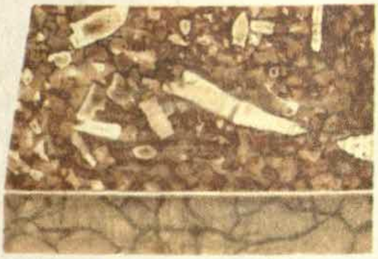
The rocks in the picture on this page are metamorphic rocks. Some of them look a great deal like the rocks they were made from. But not all of them do.

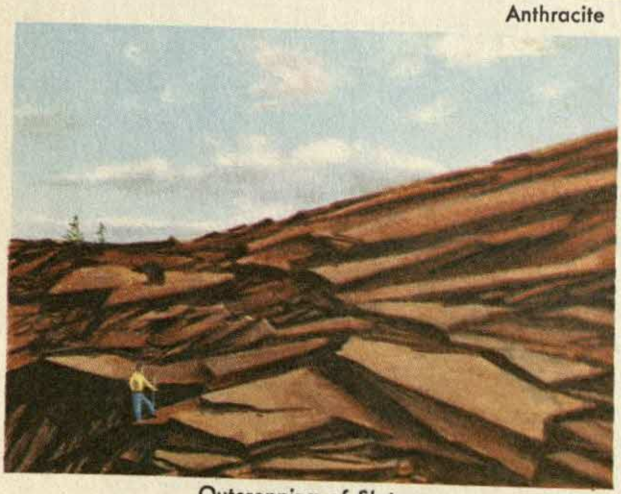
METAMORPHIC ROCKS

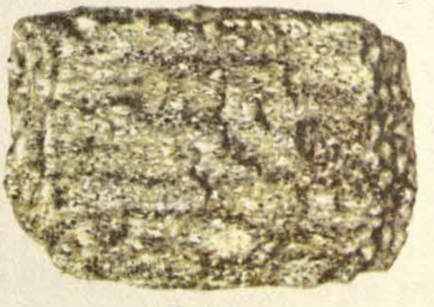
Gray Slate

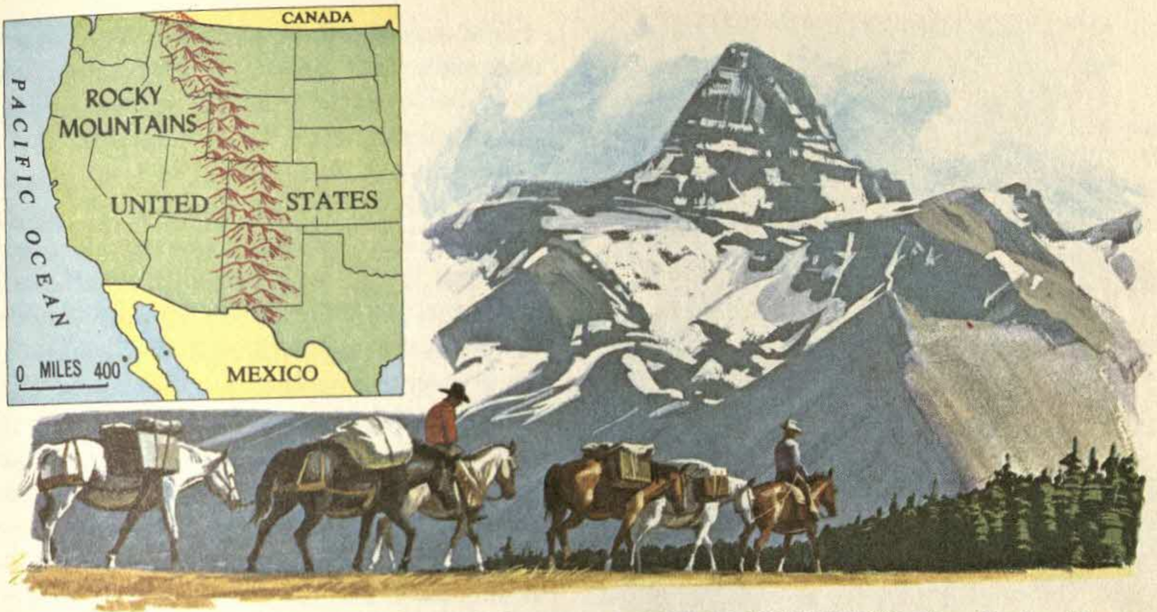
Red Slate


Anthracite


Polished Marble


Outcropping of Slate


Gneiss



Hard coal, or anthracite, is formed from soft coal. It is much harder than soft coal and is much cleaner to handle.

Gneiss (NICE) may be formed from various rocks, but a good deal of it comes from granite. Gneiss that has been formed from granite is usually streaked. It is often called banded granite.

Marble, one of our most beautiful rocks, was first limestone. It often is colored. But the most beautiful and expensive marble is pure white.

Slate looks very much like the shale it is made from. But it is harder, and it has been pressed so that it splits into thin slabs. Shingles are sometimes made of slate. Blackboards are, too. Slate smells like mud when it is wet, just as shale does.

Quartzite is another metamorphic rock. It is formed from sandstone, but the grains of sand cannot be felt. Quartzite is so hard that it can be used as paving stone.

Scientists study rocks partly because they can read the story of the earth from them. For long, long ages there were no people on the earth. All that anyone knows about what happened in the time before man has been learned from rocks. (See CHALK; COAL; EARTH HISTORY; EROSION; FOSSILS; GEOLOGY; MINERALS; PEBBLES; QUARTZ; SALT; VOLCANO.)

ROCKY MOUNTAINS The Rocky Mountains are sometimes called the backbone of North America. They run all the way from Alaska down through Canada and the United States to Mexico. The Rockies are made up of several ranges.

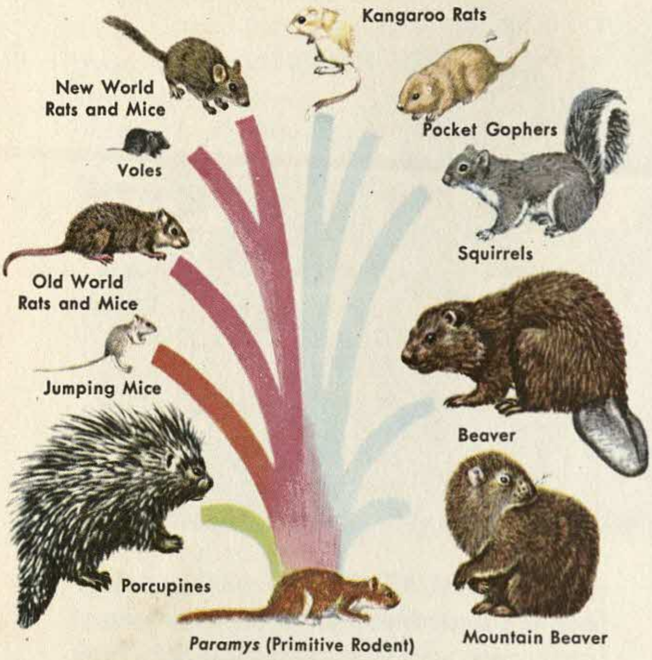
These mountains got their name because many of them are so high that no trees grow on the top. Bare rocks show there. On some of the mountains in the Canadian Rockies there is snow all year.

Pikes Peak, in Colorado, is probably the most famous peak in the Rockies. But it is not the highest. It is 14,110 feet tall. There are dozens of higher peaks.

In early days the Rockies made travel from the east coast to the west coast very hard. There are no easy ways through them. But they give North America some of its most beautiful scenery and most popular year-round vacationlands.

For much of their length the Rockies make what is called the Great Divide. The rain that falls to the west of the Divide runs toward the Pacific. The rain that falls to the east of it runs to the Arctic Ocean, the Atlantic, or the Gulf of Mexico.

These great mountains are young, as mountains go. They are only about 65 million years old. Many mountains are much older. (See MOUNTAINS.)



RODENTS The rodents are often called the gnawing animals. They get this name because they can gnaw nuts and other kinds of hard food.

There are hundreds and hundreds of kinds of rodents. In the group are all the rats and mice and all the tree squirrels and pocket gophers. In it are the chipmunks, beavers, woodchucks, porcupines, and many other animals.

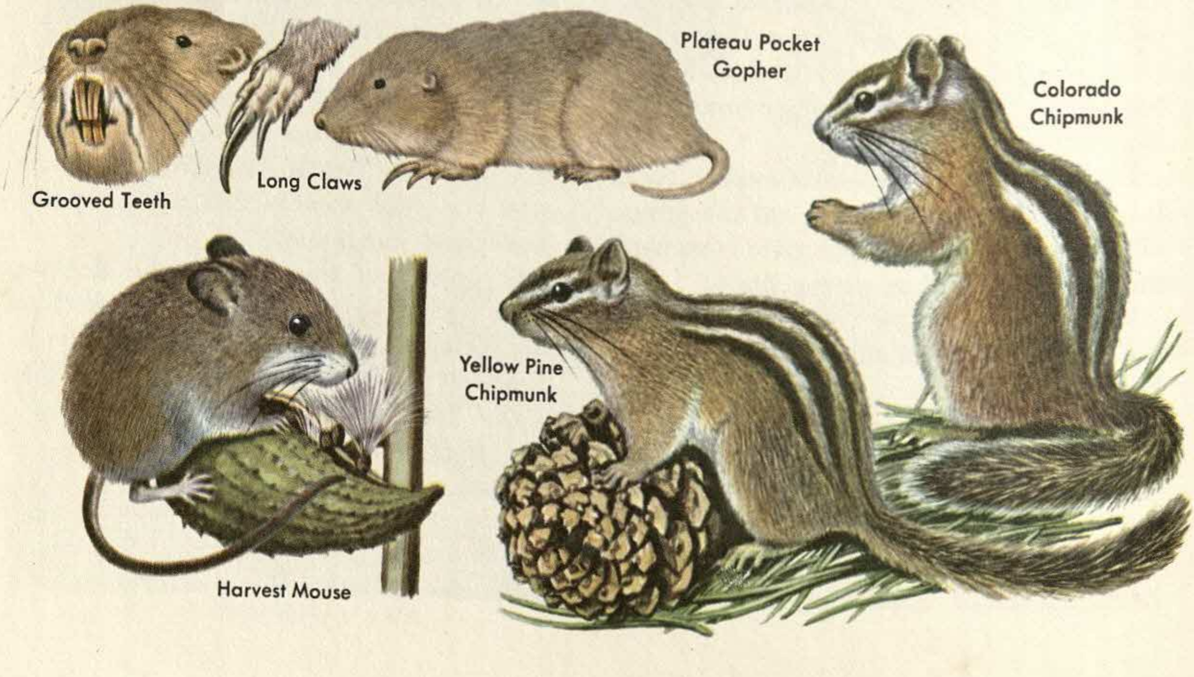
The rodents are mammals. Like all other mammals, they have fur. They also feed their babies milk from their own bodies, just as all mammals do.

Rodents are found in all sorts of places. Most of them live on the ground. Some, however, live underground, and some live in trees. Some live in swamps or streams, and some live in deserts. There are rodents in very warm regions and in very cold ones. Some even come into our houses to live whenever they have a chance.

Rodents are good gnawers partly because they have sharp front teeth. Besides, these teeth keep growing all the time. If they did not, they would soon wear down. Rodents' jaws are also especially good for gnawing. They can move up, down, backwards, forwards, and sideways.

Rodents for the most part are plant eaters. Some of them have pouches in their cheeks in which they stuff food. People often feed chipmunks for the fun of seeing them fill their pouches. Some rodents, including chipmunks, store up food in the fall. These rodents are almost the only mammals besides people that lay in food for winter.

Not all the gnawing animals are our friends. Field mice, for instance, do a great deal of damage to crops. The house mouse

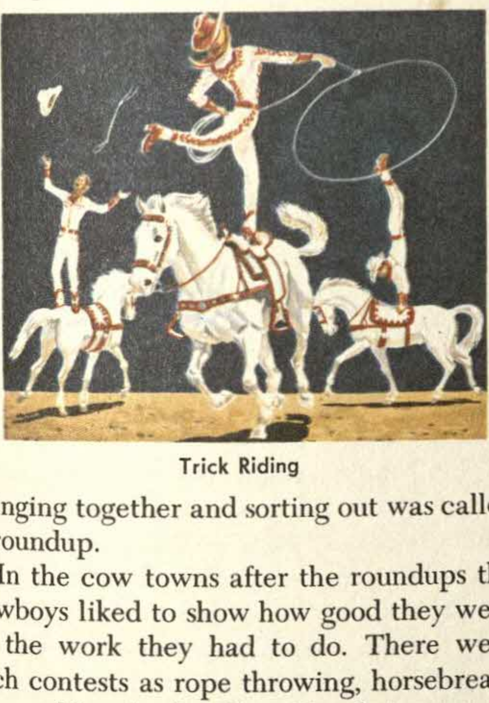


is a nuisance in our houses. Rats sometimes spread such terrible diseases as typhus and bubonic plague.

The biggest rodent is the capybara of South America. It is over a yard long, and it may weigh 100 pounds. The smallest rodents, the mice, are found all over the world. (See BEAVER; CHINCHILLA; HAMSTER AND GERBIL; JERBOA; LEMMING; PORCUPINE; XERUS.)

RODEO A rodeo is a cowboy show. Rodeos began in the early days of the West. They developed from the yearly roundups.

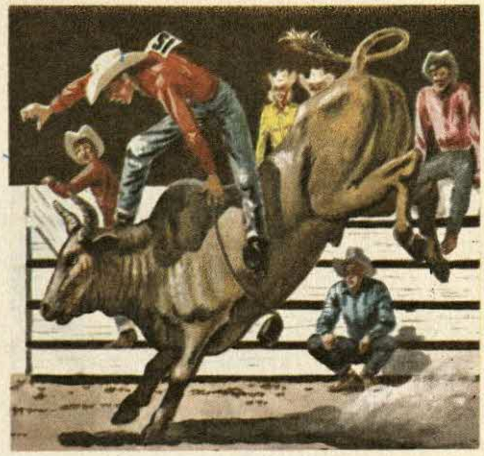
In those early days the cattle roamed over the plains for most of the year. But once a year the cowboys drove them all together. Then they sorted out the cattle that belonged to each ranch owner. Such a bringing together and sorting out was called a roundup.



Trick Riding

In the cow towns after the roundups the cowboys liked to show how good they were at the work they had to do. There were such contests as rope throwing, horsebreaking, and bareback riding. For their contests the cowboys began using the Spanish word *rodeo*, which means "a going round."

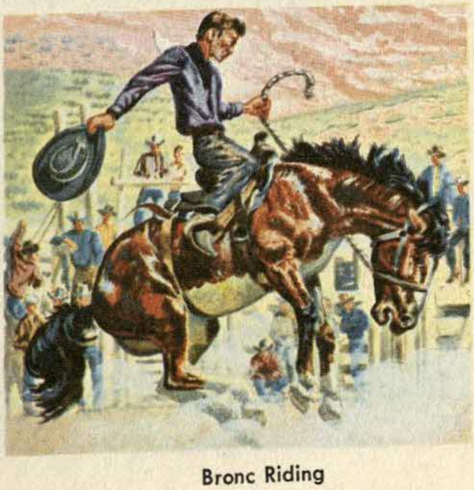
Later, fences were built on the ranges and each ranch owner kept his cattle inside his own fences. Roundups were not needed. But the cowboys kept on having rodeos. Other people knew about them and began coming to see them. They were willing to pay to see them. Soon bands of cowboys began traveling over the country holding rodeos in different places. At first always an outdoor show, rodeo has moved to the indoors for winters. It is a year-round sport. Among the famous outdoor rodeos are those held in Tucson, Ariz.; Cheyenne, Wyo.; and Calgary in Alberta, Canada. Rodeo is now popular in Australia and in Chile, too.



Bull Riding

Most rodeos have the following official contests: saddle bronc riding, bareback bronc riding, bull riding, calf roping, steer roping, and steer wrestling, or bulldogging. Often they also have fancy roping, trick riding, and stunts by clowns.

Contestants pay a fee to enter a rodeo. Money prizes are given to the winners in each event. Strict rules for the contests are enforced by rodeo associations.



Bronc Riding

Battle of Roncesvalles

ROLAND On a rocky ledge overlooking a village in northern Italy, an old story tells, two boys, Roland and Oliver, watched together in awe. Charlemagne and a thousand of his warriors were riding up the valley. The king was on his way to the governor's castle for a few days of rest.

Roland and Oliver were close friends, though Oliver, who was the governor's son, lived in the castle, and Roland's home was a cave in the hills. Neither boy dreamed that when the great king rode away they would ride with him.

But they did. Roland, it turned out, was the king's own nephew. And when he made himself known to Charlemagne, Charlemagne was delighted. He was pleased with the boy and happy to have him for a nephew.

There are many stories about Roland and his marvelous adventures. He is one of the great heroes of the Middle Ages. The tales tell of Roland's great strength, of his courage in battle, and of the mighty blows he struck with his great sword Durendal in fighting the enemies of Charlemagne. For hundreds of years the stories were sung all over France. When they were first written down no one is sure. The oldest and most famous one that has come down to us—the *Song of Roland*—was written in the 12th century. It is among the earliest works of French literature.

There is not much truth in any of the stories of Roland. They are legends rather than history. But some of the people they tell about really lived, and the *Song of Roland* tells of an actual battle that took place in the eighth century near Roncesvalles, Spain, in the Pyrenees Mountains. A *Hruodlandus* (Roland) is listed in a report of the battle as among the dead. Perhaps he was the Roland of the story.

The *Song of Roland* tells how Charlemagne, having conquered troublesome Moors in Spain, came to terms with them. He and his army turned for home. Roland and Oliver, with 2,000 of Charlemagne's best warriors, were left as rear guard at a narrow pass in the mountains as the main army went on. Only Roland's stepfather Ganelon, the man Charlemagne had sent to arrange the peace, knew that there was to be a surprise attack at the pass. He had made sure Roland would be there. Ganelon hated his stepson. He blamed Roland for his having been given the dangerous assignment of going to the enemy camp to represent Charlemagne at the peace table. In vengeance he had plotted with the Moors to kill Roland.

When Charlemagne was safely far away, 40,000 Moors swarmed into the pass. Oliver saw that there was no chance for the small band of Franks against the enemy hordes. He begged Roland to sound a great ivory horn that would call Charlemagne back. But Roland was too proud to do so.

The Franks fought fiercely. Thousands of the Moors fell under their swords. But other thousands came to take their place. Not until there was only a handful of his men left alive did Roland sound the horn. Far in the distance Charlemagne heard and turned back. But it was too late when he reached the pass. The Moors had fled, and Roland and all his band were dead.

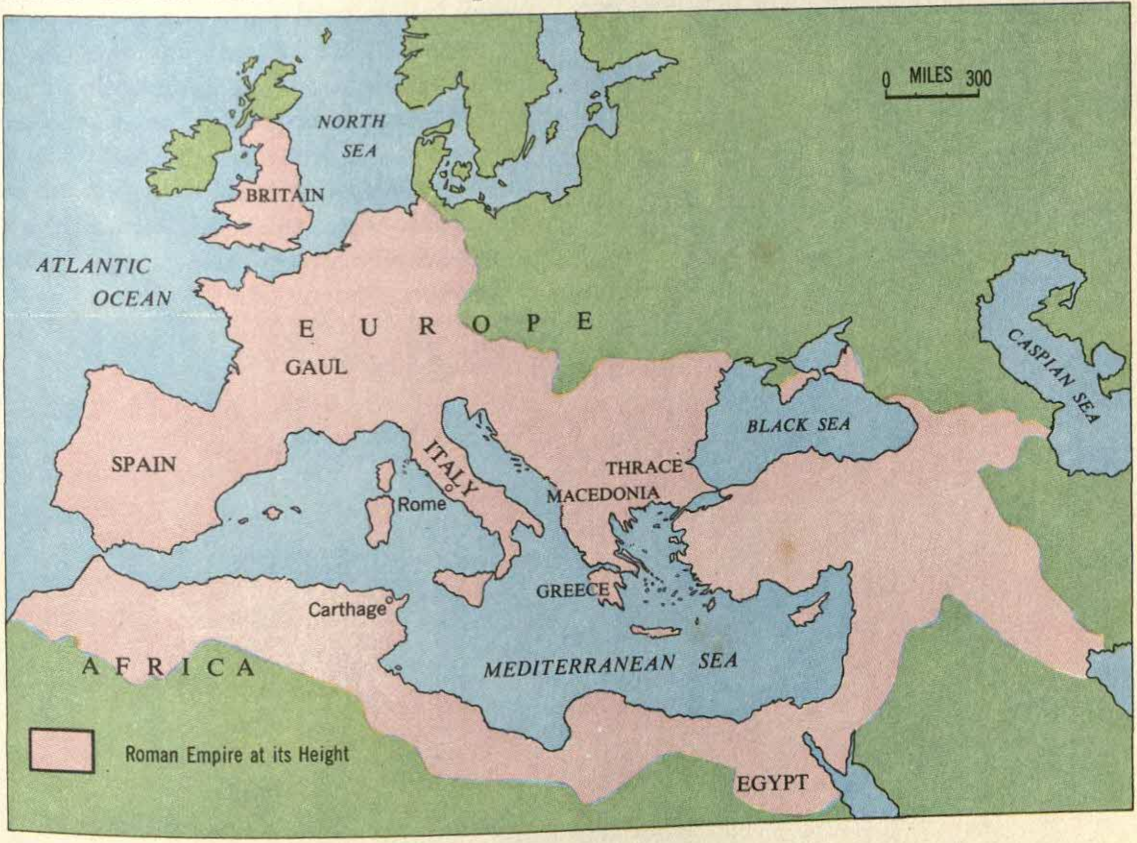
The legend tells that in France that day terrible storms had foretold the death of Roland. The sky was black as midnight. Winds blew and thunder rolled. People thought that the end of the world had come. (See CHARLEMAGNE; MOORS; MYTHS AND LEGENDS; TROUBADOUR.)

Romulus and Remus

ROMAN EMPIRE Roman children long ago were told a curious legend about the beginnings of their city. Twin babies named Romulus and Remus, the legend said, were separated from their parents. The twins were found and nourished by a wolf that had lost her cubs. When the twins grew up, they founded Rome. Romulus became the first king. The year is said to have been 753 B.C. Roman children today learn the true history of the beginnings, rise, and fall of the Roman Empire. They are proud of what Rome gave to the world.

About 3,000 years ago shepherd farmers from central Europe fought their way southward into the central part of the peninsula of Italy. Some of them, called Latins, built straggling villages on the seven hills overlooking the Tiber River. Gradually these villages united into one town—ancient Rome—ruled by a king.

The homes of these early Romans were one-room mud houses. A square hole in the roof let out the smoke of the cooking fire. There were no schoolhouses. The fathers taught their children to respect their parents, the Roman laws, and the Roman gods. The men worked in the fields and left their plows when necessary to fight for Rome against neighboring enemies. With hard work and soldiering, the Romans became a brave and sturdy people. They learned a great deal from the Etruscans, their neighbors to the north who, for most of the sixth century B.C., even ruled over Rome. The Etruscans knew how to work with metals. They were great builders and traders, too.



Roman Gladiators

About 500 B.C. the Romans set up a republic. They elected not one, but two, rulers called consuls. Either one of the consuls could stop the other from carrying out any plan by calling out "Veto," which meant "I forbid." The republic was not democratic at first, but in time all freemen gained a share in the government.

The Romans planted many colonies throughout central Italy. They conquered one after another of their neighbors. In about two centuries Rome became the master of the Italian peninsula. It wisely made allies of some of its former enemies. Among them were the Greek colonies of southern Italy. Here Romans saw for the first time beautiful temples and outdoor theaters. They admired Greek ways of living.

In northern Africa, across the narrow "waist" of the Mediterranean Sea, stood the only rival of Rome in the west. It was rich and beautiful Carthage, the queen of the western Mediterranean. The growing sea trade of Rome brought trouble with Carthage. Wars between Carthage and Rome lasted almost 120 years. The young and handsome Hannibal, at one time the general for Carthage, marched his army and war elephants from Spain over the snowy Alps and invaded Italy. Later, Roman armies followed Hannibal to Africa and defeated the Carthaginians. They burned Carthage to the ground. While Rome was fighting with Carthage, she was also pushing eastward. By 133 B.C. a vast Roman empire rimmed the Mediterranean.

Now many Romans grew rich by plundering their new provinces and by trading. Children of wealthy Roman families saw their simple homes replaced with handsome houses. The houses were built around gardens, and had many rooms. There were baths, toilets, and pipes for hot-air heating. Rooms were decorated with pictures, marble statues, and fine furniture from conquered Greece. A "janitor," or doorkeeper, stood at each front door. Every man of wealth had many household slaves.

The Romans opened schools, with educated Greek captives the teachers. Roman

Roman Amphitheater

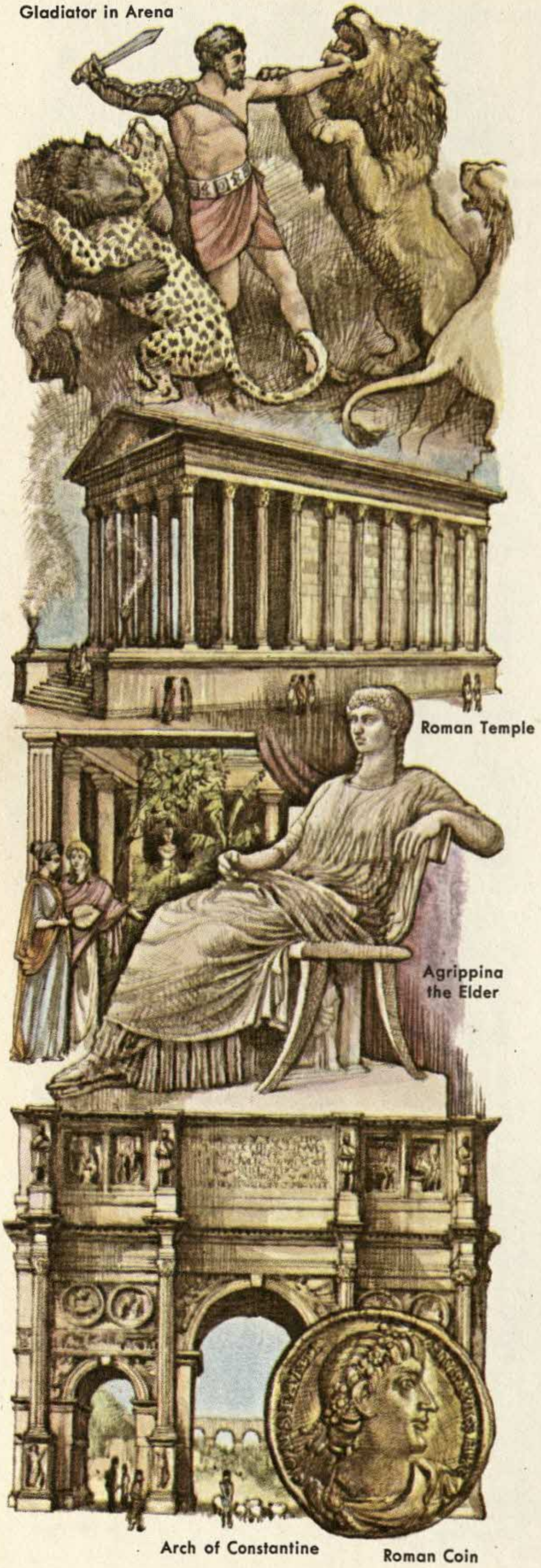
children read a primer of Greek stories translated into their own native language—Latin. Many Roman boys went east to Athens for their higher education. All educated Romans spoke both Greek and Latin. They wrote Latin histories, plays, and poems in Greek style. These were the golden days of ancient Rome.

Unhappily, there were still many poor and uneducated people in Italy. Soldiers returning from wars could not earn much on their little, neglected farms. They were not needed on the great estates of the wealthy, for those were worked by slaves. Many families left their farms and wandered into Rome. There they lived in slums, ate handouts from the government, and spent much time at free entertainments: chariot races and contests between gladiators and wild beasts.

The great difference between rich and poor helped bring about a century of civil war. Some military leaders fought for the poor against the leaders of the government and the rich. Julius Caesar was one of these military leaders. For ten years Caesar had fought to push the borders of Rome's empire to the north. He had conquered what is now France and had even led his soldiers into the British Isles. But in 49 B.C. he came back to Rome. Soon he made himself dictator. Caesar was stabbed to death in 44 B.C. by enemies who wanted no change in the republic.

In 30 B.C. Octavius, Caesar's nephew and adopted son, won a victory in the civil war. Octavius, who became the first real emperor of Rome, was called Caesar Augustus. In place of the old, failing republic he set up a good, strong government for Rome and its empire.

Two peaceful centuries followed. Roman emperors enlarged the empire till it extended from what is now Scotland almost to India. Emperors tied the empire together with excellent stone roads. They made it strong with armies, wise governors, and good laws. Farming and trade prospered.



Little villages like London and Paris became important trading towns.

The emperors rebuilt much of Rome in marble. Rome became a city of grandeur. In the great Colosseum, which could be flooded, even mock sea battles were held.

Missionaries brought the Christian faith to Rome. In 313, under Emperor Constantine, Christianity became the leading religion of the Roman Empire.

But before the time of Constantine Rome had shown signs of weakening. Some emperors were cruel. To live richly, they overtaxed the people till farmers and merchants suffered. As the empire became weak, uncivilized northern tribesmen burst across the river borders and settled inside the empire. Then Persia became a threat in the East. Because of that threat Constantine moved the capital to the old Greek city of Byzantium on the Bosporus. Its name was changed to Constantinople in his honor.

After Constantine's time the empire was divided into an eastern and a western empire. This division gave the uncivilized tribesmen their big opportunity. They conquered Rome. The last of the emperors in Rome gave up his throne in 476. The western empire soon fell to pieces and no one could put it together again. The eastern empire lasted much longer. It came to be called the Byzantine Empire.

The story of Rome's rise and fall is not, however, its whole story. The broken bits of the western empire became the modern countries of western Europe. Latin became the mother language of Italian, French, Spanish, Portuguese, and Rumanian. The Roman laws became a part of the legal systems of European and American countries. The early Christian Church, spreading from Rome, preserved Greek and Latin writings. Many cities throughout the world still copy the Greek-Roman styles of building. We owe a great deal to the city of the seven hills. (See CAESARS; HISTORY; LATIN; LAWS; ROME.)

ROMAN GODS AND GODDESSES The Romans had many gods and goddesses. Their gods and goddesses for the most part were really the same as those the Greeks worshiped. But the Romans as a rule gave them different names. We hear the names the Romans used much oftener than we hear the Greek names. The Greeks called their god of war Ares (AY reez). We almost never hear the name Ares. The Romans called this god Mars. We often hear the name Mars.

We know the names of some of the Roman gods and goddesses very well because of the planets named after them. Naming the planets for ancient gods began long ago. Some of the planets were not discovered till after the telescope was invented. But scientists have kept on giving them the names of Roman or Greek gods.

Jupiter was the king of the gods. He threw down thunderbolts from the heavens when he was angry. It is not surprising that the biggest of all the planets in our solar system is named Jupiter.

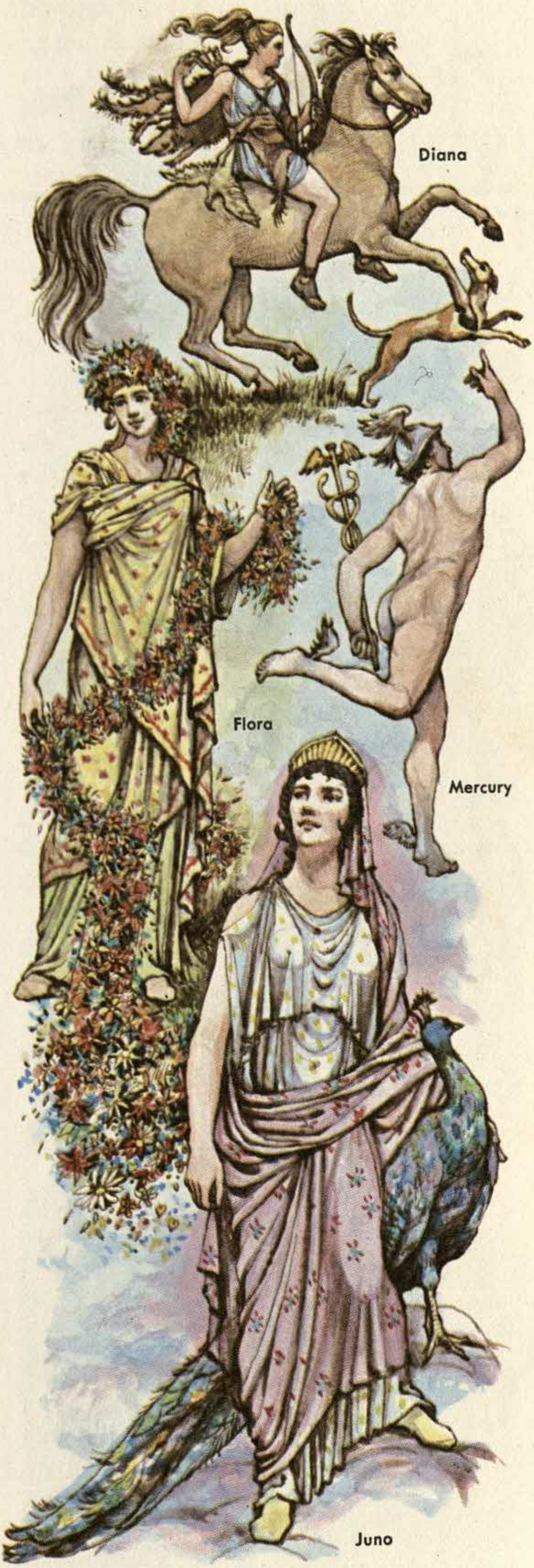
Juno was the wife of Jupiter and therefore the queen of the gods. In some of the stories they told of their gods and goddesses the Romans made Juno unpleasant. She was often bad tempered and was jealous of some of the other goddesses.

Mercury was the messenger of the gods. He wore winged sandals on his feet and could fly through the air very fast. Mercury, the planet that moves faster than any other planet in traveling around the sun, was named for him.

Venus was the goddess of beauty. The planet Venus is brighter at its brightest than any other planet.

Apollo was the god of the sun. Pictures of Apollo usually showed him driving across the sky in a beautiful golden chariot drawn by white horses.

Diana was the goddess of the hunt and protector of wild animals. She always carried a bow and a quiver full of arrows. She was also the goddess of the moon. Diana was the twin sister of Apollo.



Minerva was the goddess of wisdom. She was also the goddess of all the useful arts and the protector of towns.

Neptune ruled the seas. His scepter was a three-pronged spear. One of the distant planets was named for this god.

Vulcan was the god of fire. He was the blacksmith for the gods. His forge was deep under the ground. Our word "volcano" comes from "Vulcan."

Pluto was the ruler of the underworld. Everyone who died came into Pluto's kingdom. The planet which, so far as we know, is the outermost planet in our solar system was named Pluto.

Vesta was the goddess of the hearth. The hearth was so important a part of the home that she was really the goddess of the home. In Roman temples women called vestal virgins kept a fire burning day and night as a way of worshiping Vesta.

The planet Uranus (YOU ra nus) was named for a Greek god of the heavens, but the name is spelled as the Romans spelled it. The Greek god Zeus in time displaced Uranus as god of the heavens and king of the gods. Jupiter was the Roman Zeus.

Saturn was the god of agriculture and harvests. The beautiful planet with the rings was named for him. So was Saturday.

Besides these gods and goddesses, there were many others. The chart below lists some of them. From their names many common words have been built. Our word "vespers" comes from the name of the evening star. "Sylvan" comes from the name of the god of woods and trees. "Somnolent" comes from Somnus, the god of sleep; "January" from Janus, the god of beginnings; and "juvenile" from Juventas, the goddess of youth. (See DAYS OF THE WEEK; GREEK MYTHS; MYTHS AND LEGENDS; PLANETS.)

Flora, goddess of flowers
Janus, god of beginnings
Nox, goddess of night
Silvanus, god of trees
Somnus, god of sleep
Vesper, the evening star

Fortuna, goddess of destiny
Juventas, goddess of youth
Libertas, goddess of freedom
Portunus, sea-god of harbors
Terminus, god of boundaries
Victoria, goddess of victory

ROME Italy's capital and largest city, Rome, is so well known that there are many common sayings about it. "Rome was not built in a day" is one of them, and a true one. Rome's history goes back for more than 25 centuries.

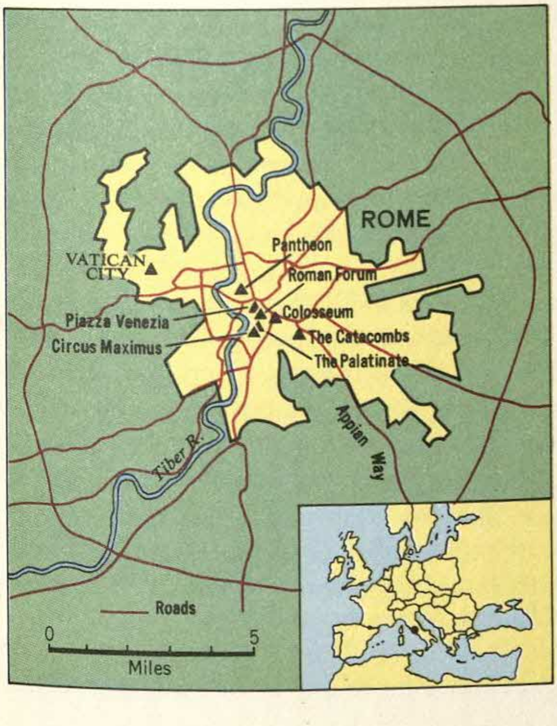
Legend says that Rome was founded by Romulus in 753 B.C. The ancient Romans counted their years from that date. It is certain that Rome was a thriving settlement by 500 B.C. It was on hills along the Tiber River at a place where the river could be crossed easily. By 200 B.C. Rome was the mistress of the Mediterranean.

The golden age of ancient Rome began when Caesar Augustus founded the Roman Empire in 31 B.C. and made Rome the capital. The city came to have more than a million people. Art, literature, and architecture flourished. Roads linked Rome with all parts of the vast empire.

The golden age ended when the Roman emperor, Constantine I, moved his capital from Rome to Constantinople in A.D. 330. Within a century Rome was overrun by tribes from the north. Many of its buildings were torn down and the aqueducts which brought water to it were ruined. For centuries it declined. But one thing started it on its way to greatness again—it became the center of Christianity. The popes made their home there. During the Renaissance great churches were built and famous arttists, Michelangelo among them, painted pictures on their walls. Sixtus V was one of the popes who helped change Rome from a medieval city to a modern one. Recently it has grown amazingly fast.

Rome is not an industrial city, although there are factories for making, among other things, chemicals, electrical apparatus, and clothing. Its leading occupations are building, making motion pictures, and managing hotels.

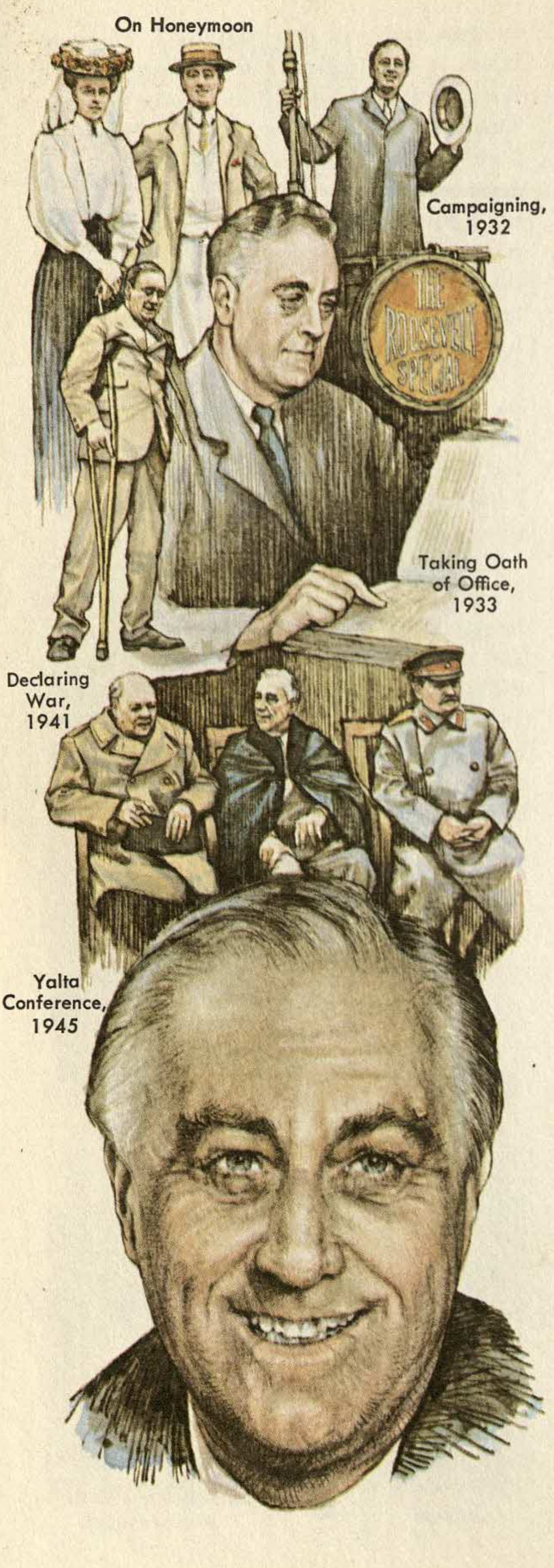
Hotels are a big business because Rome is one of the most visited cities of the world. It is a wonderful mixture of old and new. There are ancient ruins, magnificent churches, gardens, parks, and museums, as well as interesting shops. Many visitors come to see Vatican City, the home of the pope. Vatican City is a tiny independent country. Rome can boast of being the only city with a country inside it.



Roman Forum

Colosseum

St. Peter's Basilica



ROOSEVELT, FRANKLIN DELANO (1882–1945) Only one man has been the president of the United States for more than two terms. That man was Franklin D. Roosevelt, the 32nd president.

Roosevelt was born in Hyde Park, N. Y. His father and mother were James and Sara Delano Roosevelt. The family lived in a big house with spacious grounds around it. The Roosevelts were well-to-do.

The boy was an only child. Instead of starting school, he was tutored at home. Almost every year his mother took him to Europe. Summers were spent in Canada at Campobello, an island off the Maine coast.

At 14 young Franklin was sent to Groton, a private boys' school. There he got along well enough with his studies, but made few friends. When he graduated from Groton, he entered Harvard University. Here again he found the work rather easy, but he did not make a name for himself as a student. He was well liked by other students and made many friends.

After Roosevelt finished Harvard, he studied law at the Columbia University School of Law. He married a distant cousin, Eleanor Roosevelt. In two years he was ready to practice law.

When he was 28 Roosevelt became interested in politics. He was elected to the senate of the state of New York. Two years later he was reelected. But before his second term was over, the president, Woodrow Wilson, asked him to be assistant secretary of the Navy.

His work in Washington was so well liked that some of the leading Democrats began saying to themselves, "Here is a man who would make a good president." In 1920 he was nominated for vice-president. But that year the Democrats were defeated. Roosevelt went back to private business. He enjoyed very much being at his Hyde Park home with his wife and children—Anna, James, Elliott, Franklin, and John.

In 1921, while he and his family were at Campobello, Roosevelt had poliomyelitis. It left him a cripple. His legs were almost useless for the rest of his life. But many people believe that his illness helped him, too. From that time on, he seemed to understand people and their problems better. In 1928 he was elected governor of New York. Just four years later he was elected president of the United States.

Roosevelt became president when the people of the country were much discouraged. Businesses were failing and banks were closing. Roosevelt took some steps at once that gave the country hope. Very soon he started his New Deal program. This program was a great help to laboring people, farmers, and people without work. So many people all over the country thought of Roosevelt as their best friend that he was easily reelected for a second term.

Roosevelt had one way of getting in touch with the people of the country that earlier presidents had not had. He could talk to them by radio. Sitting beside his fireplace he could reach millions. He had a wonderful voice for broadcasting. Many of his talks began with "My friends."

By the time Roosevelt had finished his second term, World War II was under way. The United States was not yet in the war, but the war was affecting the country a great deal. People were unwilling to change presidents at such a time. Roosevelt was elected for a third term. Soon afterward Pearl Harbor brought the United States into the war. Roosevelt steered the country through long months of that war and conferred often with the leaders of allied nations. He was honored in many lands.

Again when it was time to elect a president Roosevelt was chosen. But he did not live to see the war end. He died in Warm Springs, Ga., on April 12, 1945.

Many lists have been made which rank the presidents. On these lists some presidents are called great, some good, and some only fair. On almost every such list Roosevelt is among those called great. (See STATESMEN; WORLD WAR II.)

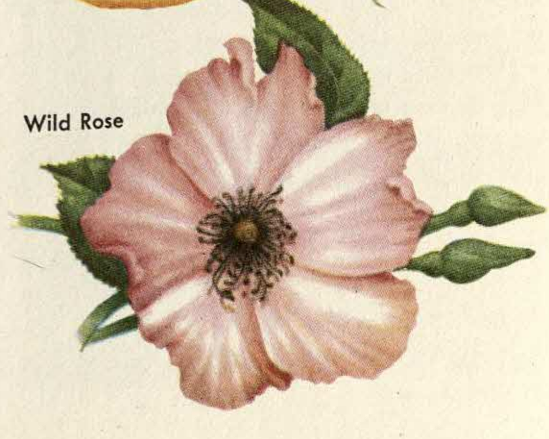
ROSES A flower shop is almost sure to have roses for sale. For roses are probably the best liked of all flowers. But roses do not have to come from flower shops. We can raise them for ourselves in our yards and gardens. Farmers even plant roses of certain kinds as fences.

There are many kinds and colors of roses. Some scramble over fences and walls, others climb up trellises, and still others are bushes. The flowers may be almost any shade of red, pink, or yellow. There are pure-white roses, too. Wild roses have five petals, but most of the roses we raise have many times five petals.

Rosebushes have seeds. They are formed in little fruits called rose hips. But if a rosebush seed is planted, the new plant may produce roses quite different from the rose the seed came from. Most rosebushes, therefore, are raised from cuttings.

All roses belong to the family of plants called the rose family. It is a big family. Apples, pears, peaches, cherries, strawberries, almonds, and bridal wreath are a few of the other plants in this big family. (See FLOWER FAMILIES; HYBRIDS.)

Hybrid Rose



Wild Rose

USES OF RUBBER

Gathering Latex, Malaya

RUBBER When the Spanish conquerors came to the New World, they found the Indians playing with balls that bounced. The balls were made from the milky juice, or latex, of a tree the Indians called *cahuchi*. The name means "weeping tree."

The Spaniards did not pay much attention to the material in the balls. They were hunting for gold and other riches. Bouncing balls did not seem important.

Two hundred years later some Frenchmen exploring the lands along the great Amazon River reported that the Indians were making shoes and bowls and bottles of caoutchouc (COW chook). This word, of course, came from the Indian name for the "weeping tree." The explorers found how the Indians got the caoutchouc. First diagonal cuts were made in the trunks of the "weeping trees." Milky juice oozed out and dripped into cups put on the trees. Caoutchouc in it was then separated from the water in the juice. This the Indians did by dipping wooden sticks into the juice time after time and then holding the sticks over a smoky fire. In the heat of the fire the water evaporated and left a coating of caoutchouc. Gradually balls of caoutchouc formed on the sticks.

When caoutchouc was taken to Europe, no one was much excited about it. Anything made of it was brittle in cold weather and sticky in hot weather. But it did get a new name. On finding that it would rub out pencil marks, the famous English scientist Joseph Priestley called it rubber.

At the time rubber got its name, a half-inch cube of it sold in England for what would be about 75 cents in American money now. If rubber cost as much today, the tires for a car would sell for about $3,000.

In 1823 a Scotsman, Charles Macintosh, began making good raincoats by putting a layer of rubber between two layers of cloth. His raincoats were called mackintoshes. In the same year a Londoner, Thomas Hancock, made the first rubber bands.

But rubber did not come into its own until Charles Goodyear, an American, made a discovery. In 1839 he found out that when sulfur was added to rubber and the mixture was heated, the rubber became much easier to use. It did not become sticky or brittle. Goodyear's way of treating rubber is called vulcanization.

Many uses were now found for rubber. Ships began traveling far up the Amazon to get it. The rubber was from the "weeping tree"—its scientific name is *Hevea brasiliensis*—of the Amazon forests. When the English found how useful rubber was, they arranged to have *Hevea* seeds brought from Brazil to England. They wanted to start rubber plantations in their own warm lands of southeastern Asia. The British plantations were a success. By 1912 more rubber was coming from the Far East than from Brazil. By 1932 rubber plantations there were producing almost all the rubber for the entire world.

On a rubber plantation the milky juice from the trees is gathered by many workers. Some of it, with a preservative added, is shipped away as a liquid. Some is made into sheets of rubber on the plantation and then packed into big bales for shipment.

The invention of the automobile stepped up the demand for rubber. In 1896 the first air-filled rubber tires were made. In that year the United States used 19,000 tons of rubber. Fifty years later the amount had jumped to more than 1,000,000 tons a year.

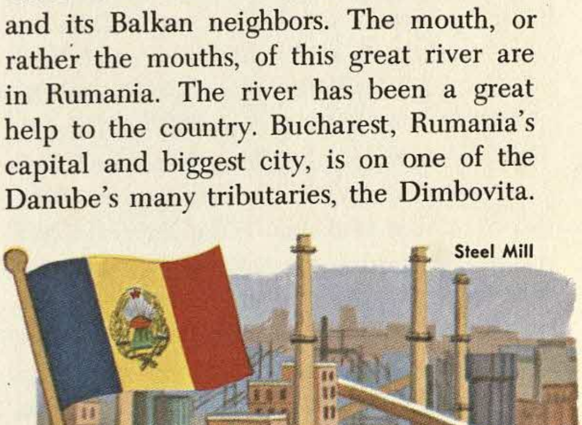
When World War II began, the supply of rubber from the Far East was shut off. Scientists had found that there were other plants with a milky juice that would furnish rubber. Goldenrod is one. But there was no hope of getting enough rubber from them. There was no hope of getting enough rubber from the wild trees of Brazil. Artificial rubber was the only hope. Soon several different kinds of artificial, or synthetic, rubber were being made. The chief chemical in most of today's synthetic rubber is butadiene, made from petroleum.

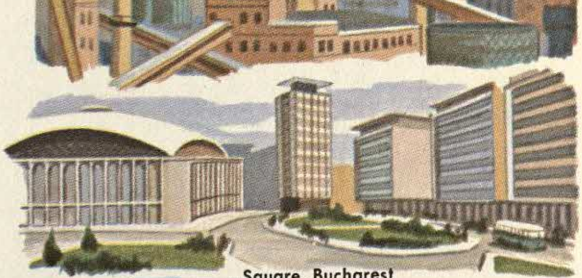
Rubber has many uses today. For some of these uses natural rubber is better. For some artificial rubber is better. For still others a mixture of the two is best. (See GOODYEAR, CHARLES.)

RUMANIA This country of southeastern Europe is sometimes called one of the Balkan States. The southern part of it is in the Balkan Peninsula. Its next-door Balkan neighbors are Yugoslavia and Bulgaria. Hungary borders it on the west, and the Soviet Union on the north and east. Since 1947 Rumania has been one of the Communist nations which are closely tied to the Soviet Union.

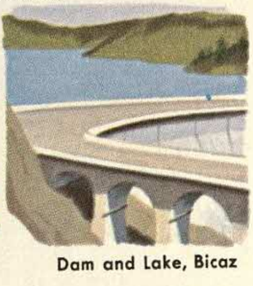
Today the country is not quite as big as the state of Oregon. It has changed size often during its history. It has had to give up part of its land to its neighbors time after time, and at other times it has gained land from them. Although it is a little smaller than Oregon, it has nearly ten times as many people. There are some 15 cities with more than 100,000.

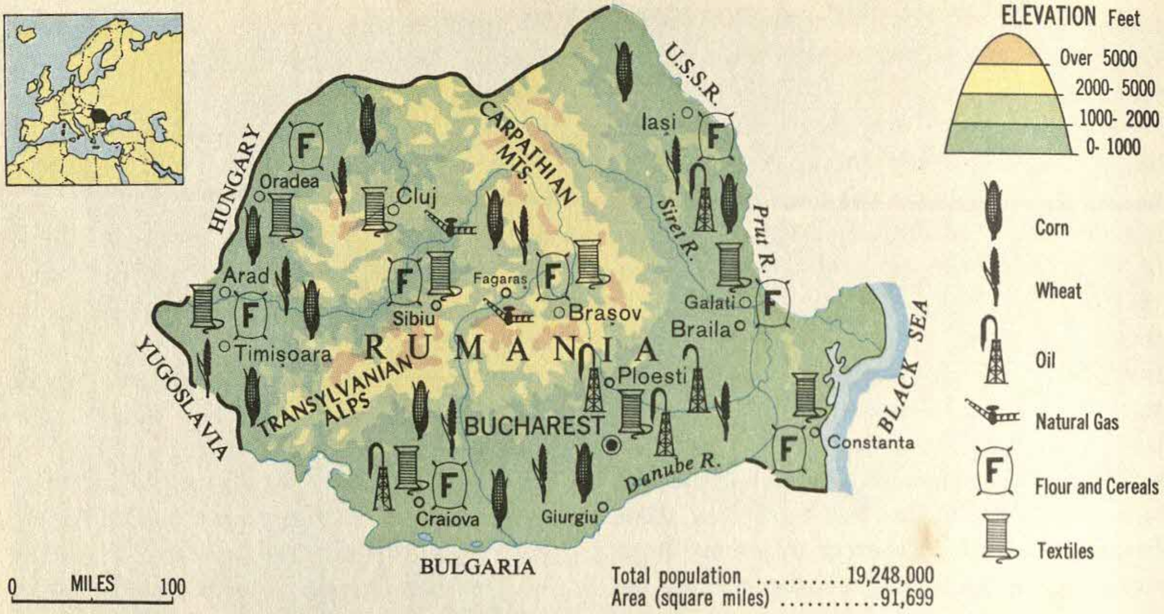
For more than 200 miles, the Danube River forms the border between Rumania and its Balkan neighbors. The mouth, or rather the mouths, of this great river are in Rumania. The river has been a great help to the country. Bucharest, Rumania's capital and biggest city, is on one of the Danube's many tributaries, the Dimbovita.


Steel Mill


Square, Bucharest

Circus, Bucharest


Dam and Lake, Bicaz



Total population 19,248,000
Area (square miles) 91,699

The central part of Rumania is mountainous. The mountains have been a kind of fortress for the Rumanians. The people could protect themselves there whenever their country was invaded. East and west of the highlands there are gently rolling plains in which there is much fertile soil. And, in most places, there is rain enough for crops. Many Rumanians are farmers. Much of the farmland is in big collective farms. Modern farm machinery and good fertilizers are used on these big farms.

As the map above shows, the main crops are corn and wheat. A kind of cornmeal mush is the chief food of many Rumanians. Among other crops raised are barley, oats, sugar beets, grapes, and sunflower seed. There are millions of sheep, cattle, and hogs. Much poultry is raised, too.

Oil and natural gas are mined in Rumania. Oil products are an important export. Coal, iron, and salt are among the other minerals mined. The number of factories has been growing. Textiles, sugar, and machines such as bicycles and sewing machines are some of the chief factory products. Others are tractors and oil-field equipment. Good timber comes from mountainside forests.

Bucharest is the chief center of trade and manufacturing. Parts of the city are beautiful. They remind many people of Paris. But other parts have narrow, crowded streets with shops like those in cities in Asia. It is no wonder. For plains near the city are part of a great natural highway between Asia and central Europe. Hordes have traveled in both directions along this highway. (See BULGARIA; DANUBE RIVER; HUNGARY; YUGOSLAVIA.)

RYE The grass family furnishes us and our farm animals with more food than any other plant family. And rye is one of the important members of the family. It is not as important as its close relatives rice, wheat, and corn, but it will grow in some places where these cereal grasses will not grow. It can stand cold better than wheat and far better than rice and corn.

Rye flour, from which rye bread and crackers are made, comes from the seeds, or grains, of rye. The seeds are also used in making rye whiskey.

The whole rye plant, grain and all, is used as food for farm animals. Rye straw, the dried stems of rye plants, can be woven into mats and hats. And it makes good litter and bedding in barns. Many farmers plant rye as pasture grass. (See BREAD; CEREALS; GRASSES.)

Ss

The letter S came from the letter ω in the earliest alphabet. Its name meant "tooth." The Phoenicians drew it with straight lines, W, so that it looked like the W of today. The Greeks turned it sidewise ʒ. The Romans wrote it with curves again, S, but not with the same curves it had in the beginning. It came down to us from the Romans without change.

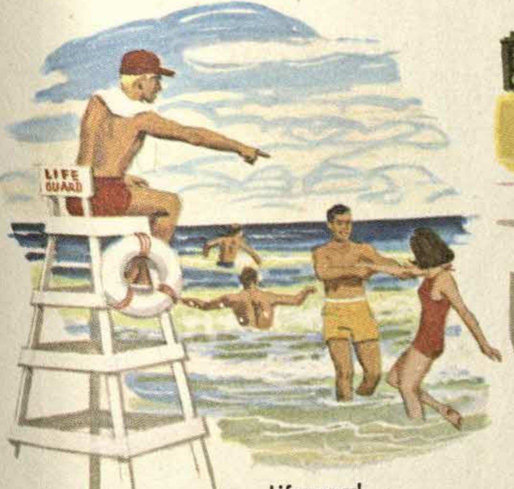
S stands for four different sounds in English words. It has different sounds in these words: *easy, sister, vision,* and *sure.*

SAFETY A hundred years ago a one-year-old child in the United States had only a fifty-fifty chance of growing up. Diseases such as scarlet fever and diphtheria killed a great many children. Today these diseases are rare. A one-year-old has a very good chance of growing up if he does not have a bad accident. Accidents are today's most frequent killers so far as children are concerned. And accidents cripple a great many children that they do not kill.

Accidents occur to children in all sorts of places—at home, on the street, at school, in public playgrounds, at places to swim, and on camping trips and boat rides. There are now many more chances for accidents than there used to be. Automobiles, power tools, electric wiring, insect and weed killers, and easy ways of starting fire have brought new dangers to guard against.

A child cannot be vaccinated against accidents as he can against smallpox. No medicine will keep him from having accidents. Of course, there are ways of lessening the chances of accidents. On the streets traffic policemen help prevent accidents. At beaches and swimming pools there are lifeguards. Tools are built to be as safe as possible. Signs give warning of danger. But a child must take much of the responsibility himself for keeping safe from accidents. Most accidents are caused by carelessness.

Of course, grown people have accidents, too. A great deal has been done to make work in mills and factories safer. There are rules of the road for making highways, railways, waterways, and airways safer. Safety is considered in designing and building such things as automobiles, elevators, escalators, and electric appliances. The



Lifeguard

Crossing Guard

Patrol Boy

Put out campfires carefully.

Steer with both hands.

Use a ladder to reach high shelves.

Obey warning signs.

Put toys away.

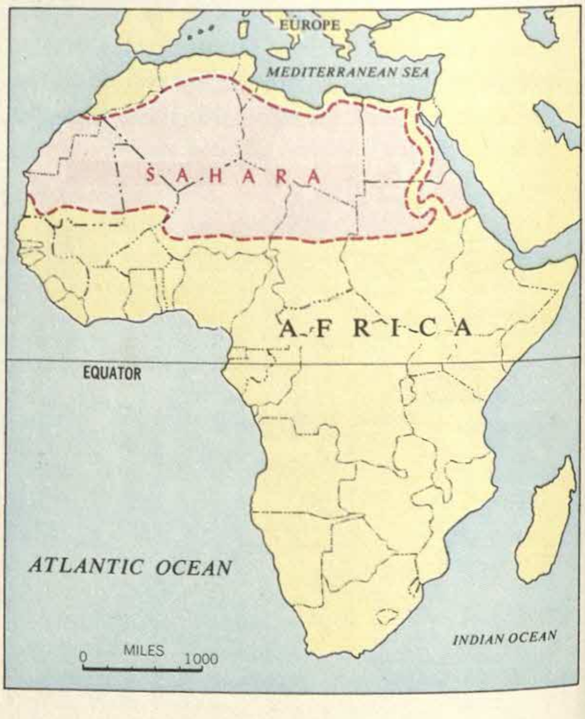
same police and guards that protect children protect grown-ups as well. But many grown-ups are careless just as many children are. Some cause accidents to themselves. Some cause accidents to others. There is an accidental death every five minutes among the people of America. Clearly safety is a problem for everyone.

SAHARA Stretching across the northern part of Africa is the hot, sandy desert called the Sahara. The Sahara is the largest such desert in the world; it is almost as big as the whole United States. In places the wind has piled the desert sand into dunes hundreds of feet high. The daytime heat is often terrific—the highest temperature in the shade ever recorded, 136.4° F., was recorded at Azizia, Libya, in this desert. But the temperature may drop 50 degrees when the sun goes down!

Oasis

Though the Sahara is very dry, there is a little rain. In some places after a rain grass grows. Herders live in the desert. They keep moving about to find grass for their camels, sheep, and goats. The herders live in tents, which are easy to move. Such wanderers are called nomads. They make their camps near waterholes.

Scattered through the Sahara there are oases, areas where there is enough water for crops. The biggest oasis is along the



Nile. It is very crowded. Many of the oases are small and have only small villages in them. The houses in the villages are brick. Their thick walls help to keep them cool in spite of the daytime heat outside. The villagers trade with the desert nomads.

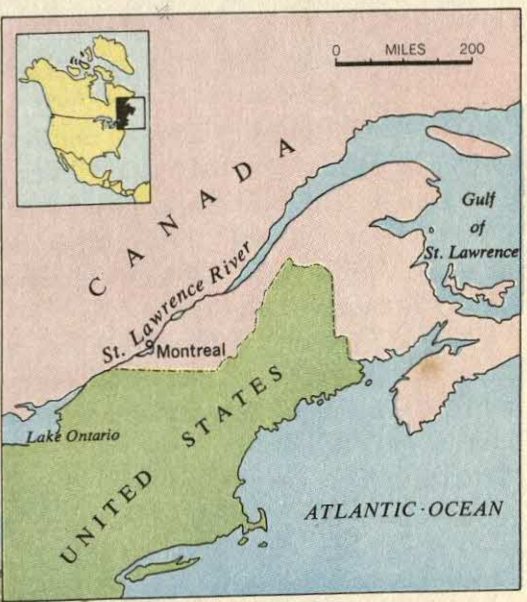
Travel in the Sahara used to be mostly by camel. A camel caravan is still a common sight there. But trucks, buses, and airplanes are seen, too. For great stores of oil have been found in the Sahara, and towns with air-conditioned houses and even swimming pools have been built near the oil fields. (See DESERTS; NILE RIVER.)

ST. LAWRENCE RIVER After the voyages of Columbus, explorers from many parts of Europe set out to find their fortunes in the New World. Some of the French explorers traveled deep into North America along a great river one of them named the St. Lawrence. French settlers followed and settled along the river.

For more than 100 miles the St. Lawrence is now the border between Canada and the United States. It carries water from the Great Lakes to the Atlantic. Together with the Great Lakes it makes a water highway more than 2,000 miles long. The St. Lawrence would be a better highway if it were not so far north. It is frozen over for several months a year.

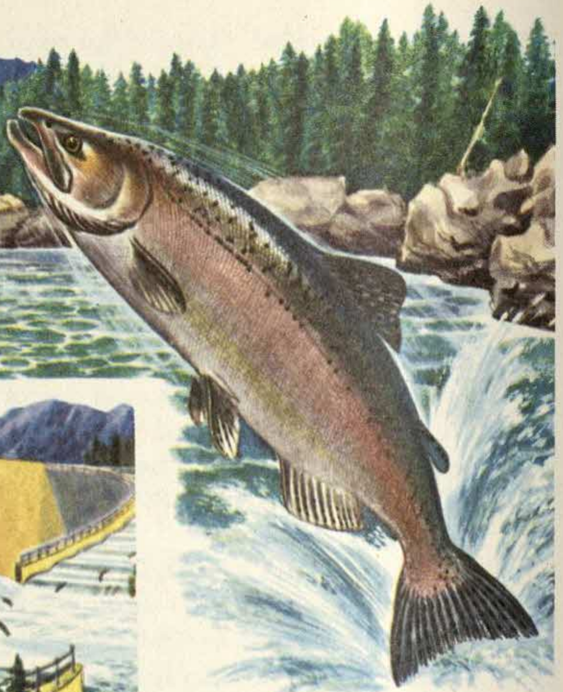
Until not many years ago big oceangoing boats could go no farther west than Montreal because of shallows, falls, and rapids beyond that point. Now the St. Lawrence Seaway makes every port on the river and the Great Lakes an ocean port.

The United States and Canada worked together on the Seaway. They deepened, widened, and straightened channels. They built new canals, locks, and dams. It is a wonderful example of how nations can work together. Along with making a better highway for boats, the Seaway furnishes electric power. (See CANALS.)

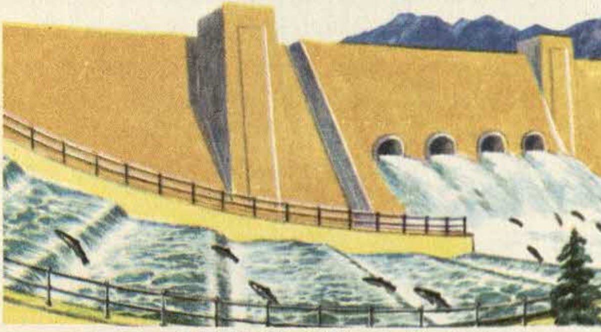


Early French Explorers on the St. Lawrence

Coho, or Silver Salmon



Chinook, or King Salmon



Fish Ladder at Bonneville Dam

SALMON Some fishes live in the ocean all their lives. Others live their whole lives in lakes and streams. Still others spend a part of their lives in salt water and the other part in fresh water. The different kinds of salmon are among these fishes.

There are several Pacific salmon and one in the Atlantic. Those of both oceans travel from fresh water to salt water and back, but their travels are not just alike.

Pacific salmon do most of their growing up in the sea. When the female salmon are ready to lay eggs, they come to shore and start up a river. Male salmon go with them. As the eggs are laid, the male salmon fertilize them. If the eggs are not fertilized they will not hatch.

The travels of the salmon upstream are often hard. The fish have to swim against the flow of the river. Sometimes they have to jump up falls and rapids. And the journey may be several hundred miles long. But the salmon cannot be lonesome, for thousands travel upstream at the same time.

On their trip upstream Pacific salmon do not eat anything. They live on fat stored up in their bodies. By the time they reach the place where they lay their eggs, they are tired and thin. They have lost their bright color. They start back toward the sea as soon as the eggs are laid. But most of them die on the way. They make only one trip to lay eggs, or spawn.

The baby salmon that hatch from the eggs may start down to the ocean when they are only a few weeks old. They may stay where they were hatched for a year or even for several years. After they reach the sea, they live there till it is time for them to make the trip back upstream.

The Atlantic salmon makes several trips to fresh water to spawn. The baby fish stay in fresh water for two or three years before they first travel to the sea.

Spawning salmon of both the Pacific and the Atlantic come back to the stream where they were hatched. They find their way, it is thought, by the smell of the water.

Salmon are among the best food fishes. There are big salmon fisheries in Alaska, Washington, and Oregon, and in Canada. Much of the catch is canned. The Columbia River is famous for its salmon; so are the Yukon and the Fraser. (See FISHES.)

SALT "He is not worth his salt." "He is the salt of the earth." Both of these are common sayings. They show that salt is an important substance. It is even more important today than in the past.

At times salt has been used as money. Our word "salary" comes from *sal*, the Latin word for salt. Roman soldiers used to be paid partly in salt.

The Arabs used to believe that eating another person's salt meant that you would do him no harm. It was a bad sign if anyone refused to eat salt when he was a guest. In some parts of Africa it is still good manners, when you meet a friend, to let him lick your cake of salt.

There are superstitions about salt, too. Spilling salt is supposed to bring bad luck. But the person who spills the salt can keep the bad luck away if he throws a little over his left shoulder. Another superstition is that you can catch a bird if you sprinkle a little salt on its tail.

Salt is something which everyone has to have. We cannot live without it. Of course, most of us like the taste of salt, too.

Seawater has salt in it. There is so much salt in the oceans that if it were all taken out and spread over the United States it would make a layer more than a mile deep. But most of the salt we buy comes from deep in the ground. It comes from layers of rock salt there. The layers were formed when salty seas of long ago evaporated. Later the salt was covered with other rocks.

Salt Mine

It is not hard to get salt from the layers of rock salt underground. Mines can be dug down and the salt taken out in blocks. Or water can be forced down through pipes to the salt and then pumped up again. The salt that has been dissolved in the water can easily be taken out of it.

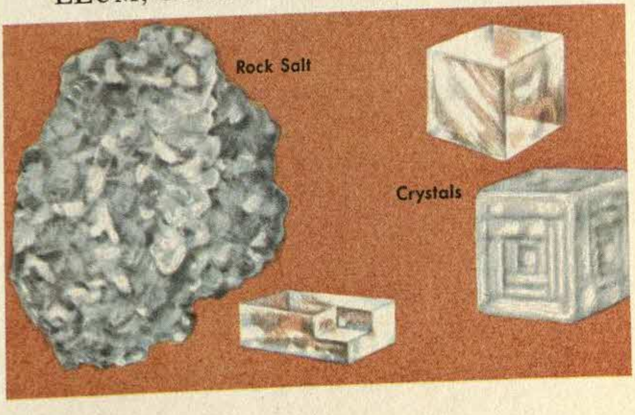
Most of the salt we buy is in tiny crystals. Under a microscope they look like little cubes of glass.

We could not use salt for money now, for it is much too plentiful. We are sure that there is enough salt in the ground, to say nothing of the sea, to last millions of years.

It is good that there is so much, for we are using huge amounts of it. We use millions of tons of salt every year.

Of course we do not use all that salt to flavor our food. We use some to keep meat from spoiling. We use some in melting the ice on streets and highways. It plays a part in making soap and glass. But we use most of it in making other chemicals.

Chemicals made from salt are used in the manufacture of gelatin, dyes, drugs, leather, and fireworks. They are used to soften water, bleach cloth, and clean metal parts. The list could go on and on. A great many of our factories of today would be forced to shut down if there were no more salt. (See COMPOUNDS; CRYSTALS; GREAT SALT LAKE; OCEANS; PETROLEUM; SUPERSTITIONS.)



SAMPLER In the early days of the United States children did not romp and play as much as they do now. For a part of every day little girls were supposed to sit quietly and sew. Often they worked on samplers.

The picture above shows a sampler. Like all samplers, it is a piece of cloth with embroidery on it. The embroidery is the kind we now call cross-stitch. Many samplers had all the letters of the alphabet embroidered on them. Many had pictures and mottoes, too.

Children seldom work samplers now, but many samplers have been handed down to us. Most of the samplers we see today are framed and are hanging on walls like pictures. Some of them are so well done that it is hard to believe that children worked them. Many museums have collections of samplers. (See SEWING.)

SAND One of the commonest of all the substances in the world is sand. It is found on the shores of nearly all lakes and seas. There is almost nothing but sand for hundreds of miles in some of the world's great deserts. Sand is found in many other places, too. Most soil is part sand.

The wind often piles sand up into hills called dunes. A sand dune may move over farms and forests as the sand is blown up one side and over the top.

Sand is formed from rocks of many kinds. There was no sand at all when the earth was new. There had to be time for rocks to break up into tiny bits. Grains of sand are formed in the same way pebbles are, but sand grains are smaller. Some sand is finer than other sand. Grains vary from 1/12 to 1/400 of an inch across. But there is room for thousands of even the larger grains in a teaspoon.

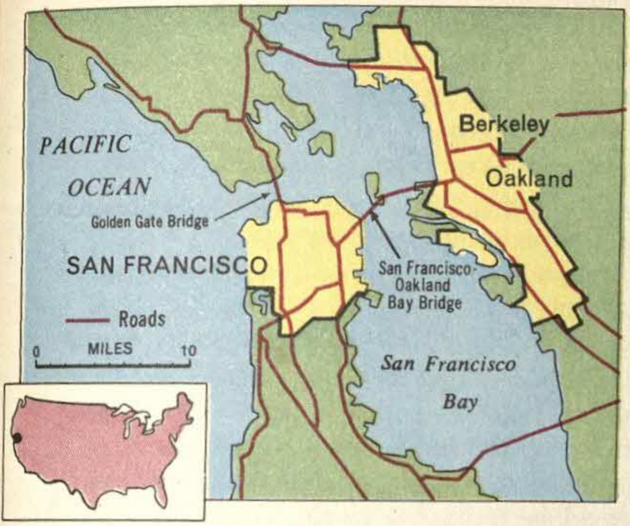
Most grains of sand are bits of quartz. Many have sharp corners. Because quartz is very hard, wind carrying sand can carve rocks into strange shapes.

Sand is useful in many ways. Glass is made of sand. Concrete has sand in it. So has the mortar used in building walls of stone or brick. The big filters for filtering water are filled with sand. Sandpaper is used in every tool shop. The list of uses for sand could be made long. (See CONCRETE; DESERTS; DUNES; EROSION; GLASS; QUARTZ; ROCKS.)

SAN FRANCISCO Spread over hills on the peninsula south of the Golden Gate is the city of San Francisco. The Golden Gate is the narrow entrance from the Pacific Ocean to San Francisco Bay. No other city has such a setting as San Francisco's. From such places as the "Top of the Mark" one gets magnificent views of the gorgeous setting and what man has built there. "The Mark" is short for the Mark Hopkins, a hotel near the heart of the city.

To the north is the long, orange bridge across the Golden Gate. It is so high that the largest ocean vessels easily go under it. To the east is the San Francisco-Oakland Transbay Bridge. This double-deck bridge is over eight miles long. The two bridges link the city to the east bay area and to the redwood forests, farmlands, and oil fields of California.

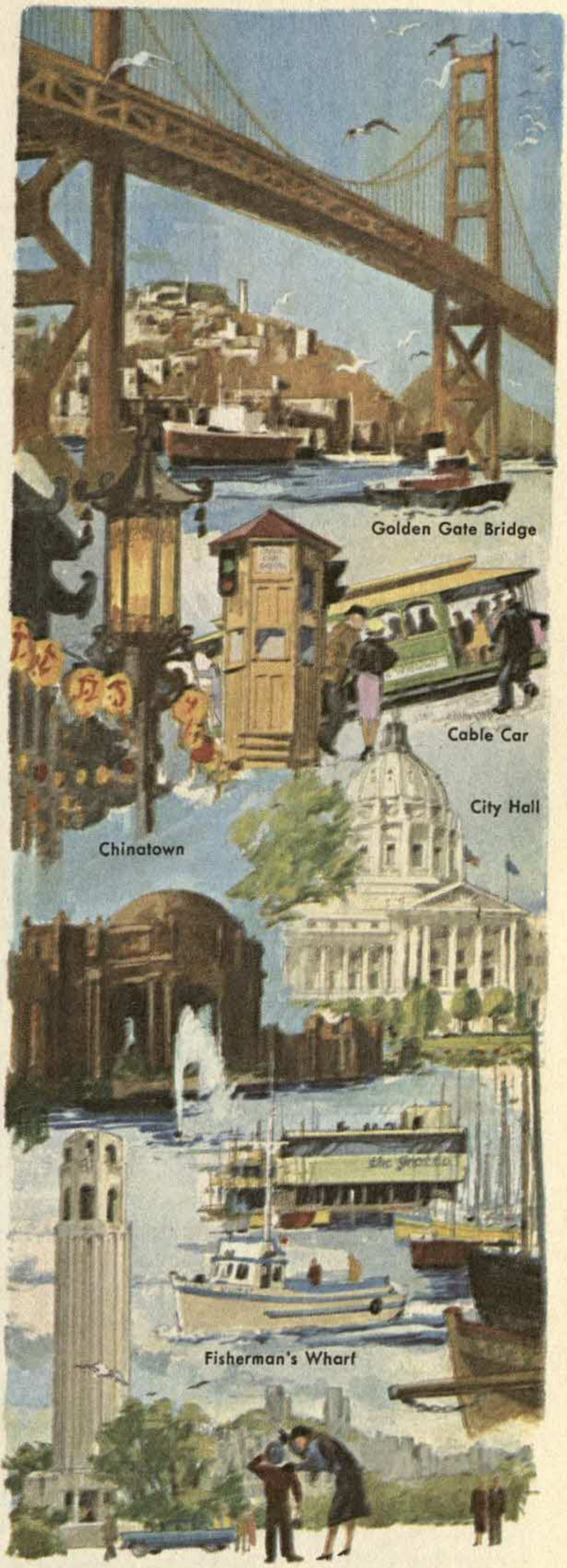
Skyscrapers and other fine buildings mark the business district. Streets lead down from it to the busy bay waterfront. Here are warehouses, and docks for ships of many kinds. Other streets lead up from the business center to the homes on the upper slopes of the hills. Many streets are



very steep. It is not easy to walk up these streets. But cars, buses, autos, and cable cars make the climb. Visitors often ride the old and noisy cable cars, one of the unusual things that make San Francisco different. High on the hilltops and on the upper slopes are beautiful parks, winding drives, and lovely homes.

San Francisco is a city of nearly three-quarters of a million people. It is a manufacturing and trade center. Many people from the east bay area come into San Francisco for work and for play. Its colorful past adds to the charm of the city. People from many lands came at one time or another and left their mark on the city. Spanish explorers and missionaries were among the earliest to come. The Gold Rush in 1849 brought people from almost all the countries of the world. There are many Chinese in San Francisco. Chinatown makes visitors feel as if they were in China. There is even a Chinese telephone exchange. But the Chinese young people all speak English. The fish markets and restaurants at Fisherman's Wharf are among the city's musts to most tourists.

San Francisco has left behind the wild gaiety of the 1870's and the horrors of a great earthquake in 1906. It is today a thriving city of queenly charm and dignity. (See BRIDGES; GOLDEN GATE.)



Telegraph Hill

Fortress Castle of San Marino

SAN MARINO Only two countries in Europe are smaller than the tiny country of San Marino. They are Monaco and Vatican City. Rhode Island, the smallest state in the United States, is 50 times as big as the whole of San Marino.

This tiny country is in the Apennine Mountains. These mountains run north and south in Italy. Italy surrounds San Marino on all sides. Almost all the people of the little country are farmers.

San Marino claims to be the oldest nation in Europe. It was founded about 1,600 years ago. The rulers are elected. (See MONACO; VATICAN CITY.)

SÃO PAULO This city of southeastern Brazil is the fastest-growing city in the world. Although it is over 400 years old, it has grown spectacularly only in the past 75 years. It now has 5,000,000 people, who are called Paulistas.

São Paulo does not have the beautiful coastal setting of Brazil's other great city, Rio de Janeiro. Instead, it is on a plateau about 50 miles from the coast. But it has wide streets, towering skyscrapers, fine shops, and many ultramodern buildings.

The city owes its growth partly to the rich farmlands that stretch out from it. There are great coffee plantations, orange orchards, and fields of cotton, corn, and rice. Millions of hogs and cattle are raised. São Paulo is also a great manufacturing city. Among the products of its 35,000 factories are textiles, automobiles, chemicals, and processed foods. (See BRAZIL.)

SATELLITES The moon is a satellite of the earth. "Satellite" comes from a Latin word for "companion." The moon travels around the earth as the earth travels around the sun. Some planets in our solar system have several moons, or satellites.

Our moon has a definite path, or orbit. So does every other satellite. The moon is circling fast around the earth—about 2,300 miles an hour. It does not run away from the earth in spite of its speed, for the earth's gravity will not let it. But it is traveling too fast to fall to the earth.

As soon as scientists found that rockets could be built that would travel hundreds of miles above the earth's surface, plans for artificial moons, or satellites, were made. A satellite would be a container or platform carrying scientific instruments. It would have, too, radio transmitters for sending down messages to stations below. A multistage rocket would carry the satellite high above the earth's surface. At first the rocket would go straight up. But then it would be made to turn and start the satellite on a path around the earth.

To keep the earth from pulling it down at once, the satellite would have to reach a speed of some 18,000 miles an hour. Since the satellite would not be above the atmosphere, however, the air, although very thin, would gradually slow the satellite down. Finally it would fall toward the earth. As it fell through the air, it would get so hot that it would burn up.

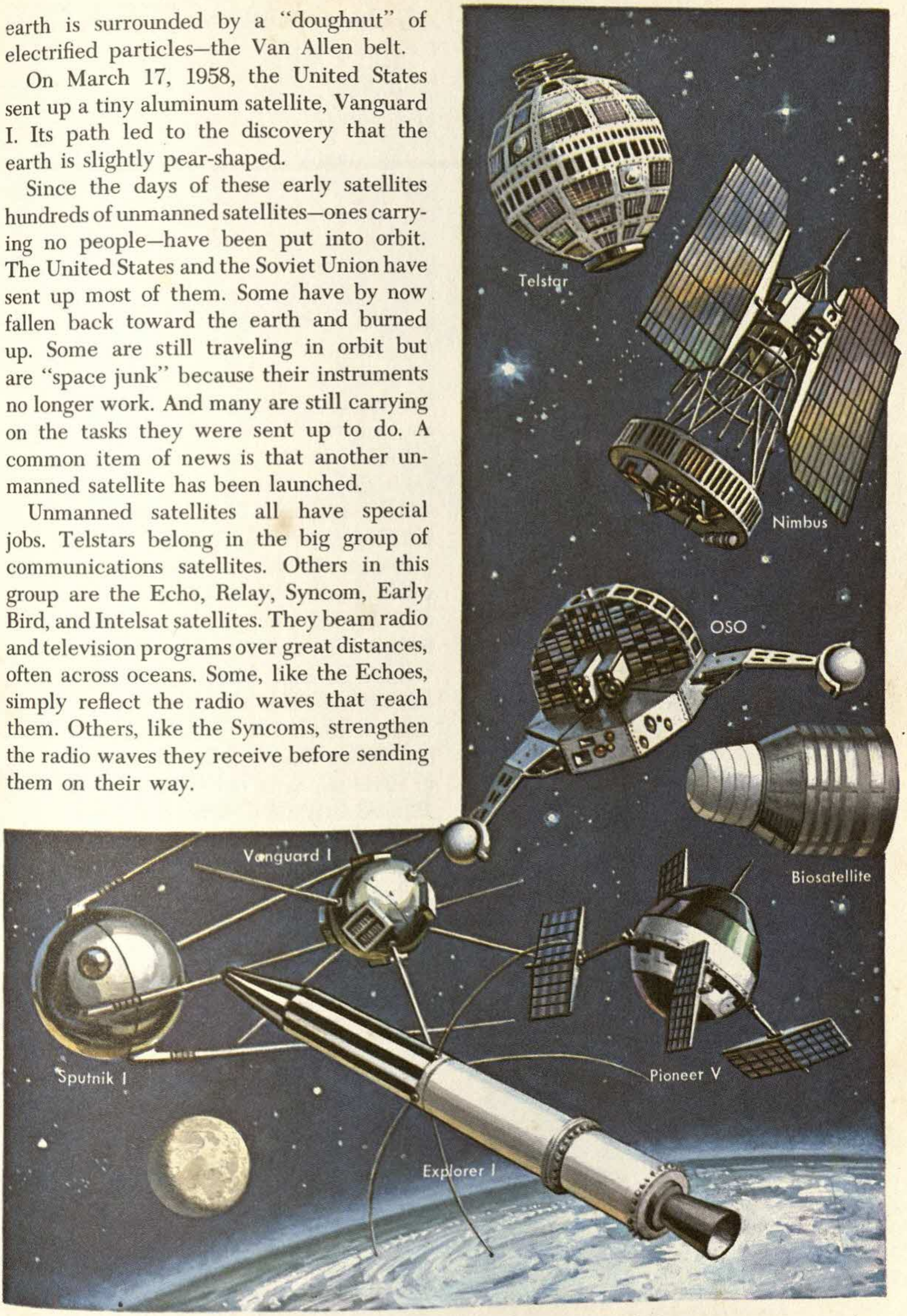
On Oct. 4, 1957, there was much excitement because the Soviet Union had succeeded in sending up an artificial moon. This moon was called Sputnik, Russian for "traveling companion." Sputnik I weighed 184 pounds. It went around the earth in a little more than 96 minutes.

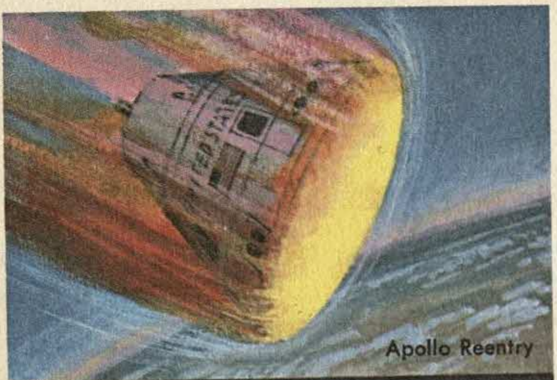
On Jan. 31, 1958, the United States launched its first satellite, Explorer I. Explorer I weighed about 31 pounds. Its orbit reached more than 1,500 miles above the earth's surface. This first American satellite made an important discovery: the earth is surrounded by a "doughnut" of electrified particles—the Van Allen belt.

On March 17, 1958, the United States sent up a tiny aluminum satellite, Vanguard I. Its path led to the discovery that the earth is slightly pear-shaped.

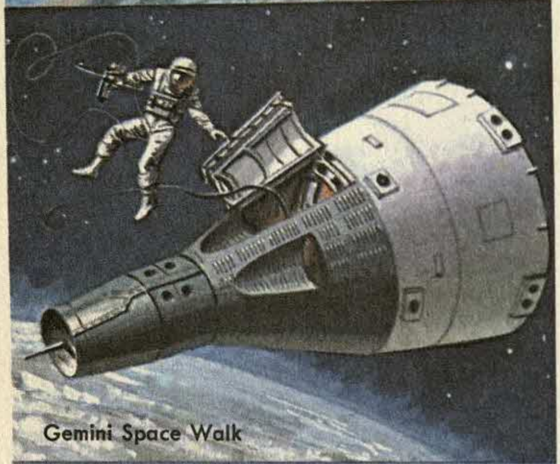
Since the days of these early satellites hundreds of unmanned satellites—ones carrying no people—have been put into orbit. The United States and the Soviet Union have sent up most of them. Some have by now fallen back toward the earth and burned up. Some are still traveling in orbit but are "space junk" because their instruments no longer work. And many are still carrying on the tasks they were sent up to do. A common item of news is that another unmanned satellite has been launched.

Unmanned satellites all have special jobs. Telstars belong in the big group of communications satellites. Others in this group are the Echo, Relay, Syncom, Early Bird, and Intelsat satellites. They beam radio and television programs over great distances, often across oceans. Some, like the Echoes, simply reflect the radio waves that reach them. Others, like the Syncoms, strengthen the radio waves they receive before sending them on their way.

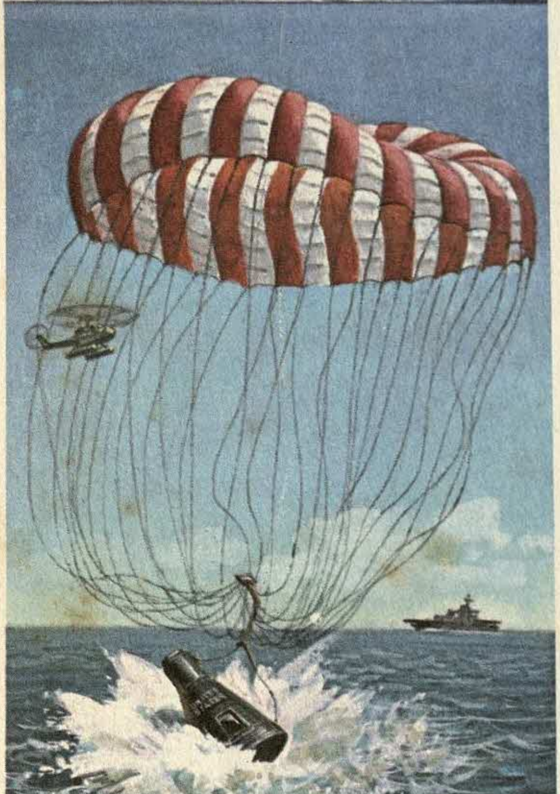




Apollo Reentry



Gemini Space Walk



Mercury Splashdown

Nimbus satellites are among the many U.S. weather satellites. Tiros and ESSA satellites are in this group, too. Weather satellites send down pictures that provide weather forecasters with a worldwide view of the weather.

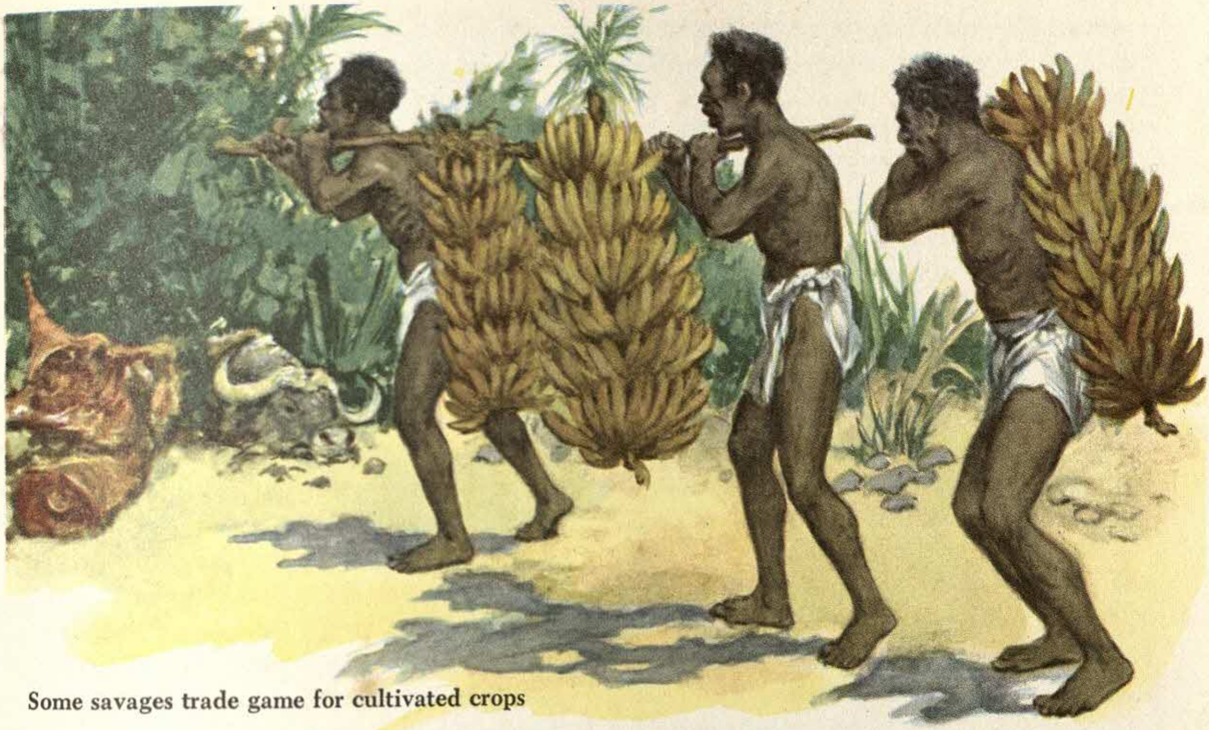
One group of U.S. satellites was nicknamed the streetcar satellites because they carry so many instruments aboard as passengers. The OSO (Orbiting Solar Observatory), OGO (Oribiting Geophysical Observatory), and OAO (Orbiting Astronomical Observatory) satellites are in this group.

Dozens of Explorer and Discoverer satellites have been sent aloft on many different missions. Biosatellites carry up small living things for a study of the effects of outer space on them. Transit satellites help with navigation. GEOS, Pegasus, and Injun are among the many others.

Pioneer V was launched with enough speed to escape from the earth and go into orbit around the sun. Signals came back from it from over 20 million miles away.

April 12, 1961, marked the beginning of manned satellites. On that day a U.S.S.R. satellite carried an astronaut around the earth once. America's first manned satellite to circle the earth did so on Feb. 20, 1962. Manned satellites were not possible till ways had been worked out of bringing them back to earth safely.

By the end of 1968 America had put 16 manned spacecraft into orbit around the earth. The first four were Mercury capsules. They carried one astronaut each. The next ten were Gemini spacecraft. They carried two men each. The fifteenth and sixteenth were Apollo capsules, each with three passengers. The Apollo was not designed for simply traveling around the earth. Apollo 7's circling of the earth 163 times late in 1968 was just a forerunner for Apollo 8's trip at the year's end. Apollo 8 circled the earth one and a half times and then shot out into space for a closeup look at the moon. (See ASTRONAUTS; ROCKETS; SPACE TRAVEL.)



Some savages trade game for cultivated crops

SAVAGES "You are acting like savages," children are sometimes told when they are cruel or when they have bad manners. Such a saying is not fair to savages. Most so-called savages follow carefully their own ideas of good manners. And not all of them are cruel. Savages are merely primitive people whose way of life does not include certain things that make up what we call civilization—such things as writing, cities, and the division of the work to be done into different occupations. Instead, they live much as our ancestors must have lived thousands of years ago.

Deep in the forests along the Amazon River in South America live what is left of such a people, the Witoto Indians. The whole tribe now numbers less than 1,000. It is made up of small, loosely connected groups called clans.

Each clan has one big house. It has a frame made of logs held together with vines and covered with a thick layer of palm leaves. There are no partitions in the house, but each family has its own place and its own fire. Hammocks made of vines and slats of wood, and benches made of logs are the only furniture. The back part of the house is the home of the chief.

Cutting down trees for a house is not easy, for the Witotos have only stone axes. Their other tools are made of wood or bone. They have no metals. They raise only a little of their food. The women gather fruits and roots from the forest. The men hunt and fish. Hunters use blowguns or traps to get wild animals for food. Sometimes the darts they use are poisoned. Fishing is done with wooden spears, bone hooks, or baskets that act as traps.

Even though these Indians cannot read or write, they know the ways of the forest. No civilized person could read as much from such signs as faint footprints, broken twigs, and bruised leaves as they do.

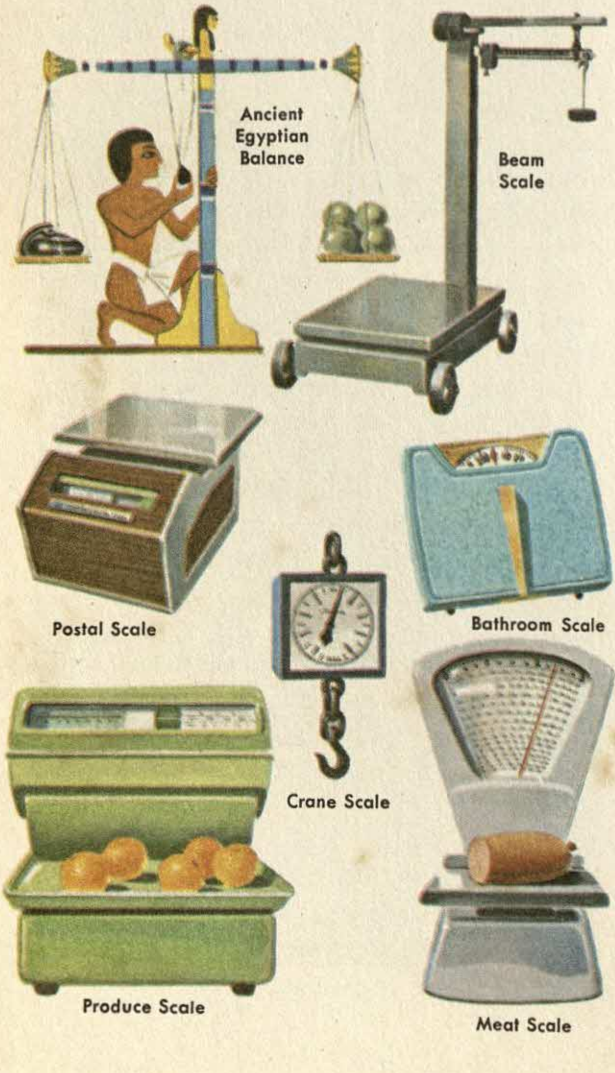
The Witotos believe in good and evil spirits. They believe, too, that some of the animals of the forest have magical powers. They are very much afraid of the jaguar and the anaconda. These particular animals are never killed for fear the group might be harmed by their magic.

Sometimes different clans fight. But they also have feasts and dances together. Drums made of hollowed-out tree trunks boom out the invitations. The drums can be heard for 20 miles.

A council helps the chief of a clan make decisions. The members even vote on important questions. They vote in a strange way. A man who has a plan explains it. Then he dips a stick into a pot of tobacco syrup. He licks the stick and passes the pot around. Everyone who agrees with him puts in a stick and licks off the tobacco.

These people never travel far from home. They fashion a few dishes of clay and bake them in their open fires. The little clothing they wear is made of soft bark.

Not many savage tribes are as backward as the Witotos. Most of those still left today live, like the Witotos, in areas far from civilization. (See CANNIBAL; ETIQUETTE; SUPERSTITIONS.)



SCALES AND WEIGHING Many things are bought and sold by weight. We buy sugar by the pound, and coal by the ton, and more precious materials by the ounce or even by the grain. To weigh out a certain amount of anything or to find out how much something weighs we use scales.

The pictures show some of the many kinds of scales that have been invented. Weighing with a simple balance is easy. To weigh out a pound of candy, a pound weight is put in one pan and the candy is put in the other till the two pans balance. Or if a buyer has picked out the candy he wants, it can be put in one pan and enough weights to balance it put in the other.

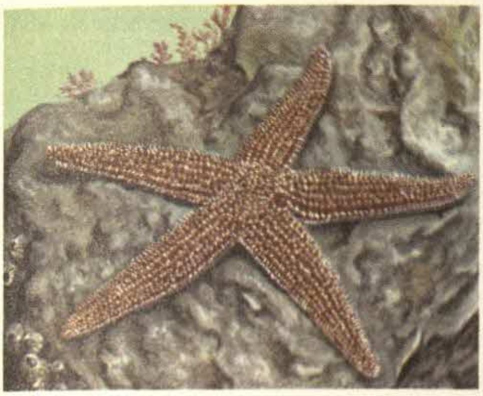
Of course, a big, loaded truck could not be weighed with a simple balance. Even if such a balance were big enough, the weights, unless a great many were used, would be too heavy to handle. On balances to weigh things that are very heavy, levers may be arranged so that a one-pound weight balances 1,000 pounds or more.

With some kinds of scales no weights are needed. Springs or levers inside the scales move a pointer on a dial.

Weighing is important for other things besides buying and selling. Doctors weigh their patients to find out what progress they are making. Mothers use scales to see whether their babies are gaining as they should. Travelers by plane weigh their luggage. Packages sent by mail or express are weighed. Scientists use scales to help them in their experiments.

Some scales are very sensitive. Some, for instance, can show that a piece of paper is heavier after a single word has been written on it.

Scales may do more than weigh. Some add; some count. A common kind figures prices. Suppose a butcher is selling a piece of meat at 68 cents a pound. He sets his scale at 68 cents. Then he puts the meat on the scale. The scale tells him both the weight and the price. (See WEIGHTS AND MEASURES.)



Starfish

Dung Beetle

Snail

SCAVENGERS Nature has a cleanup brigade—living things that use as food refuse from plants and animals and dead plants and animals. The members of this brigade are scavengers. Without them the earth would not be fit to live on. Scientists have a special name for plant scavengers. They call them saprophytes.

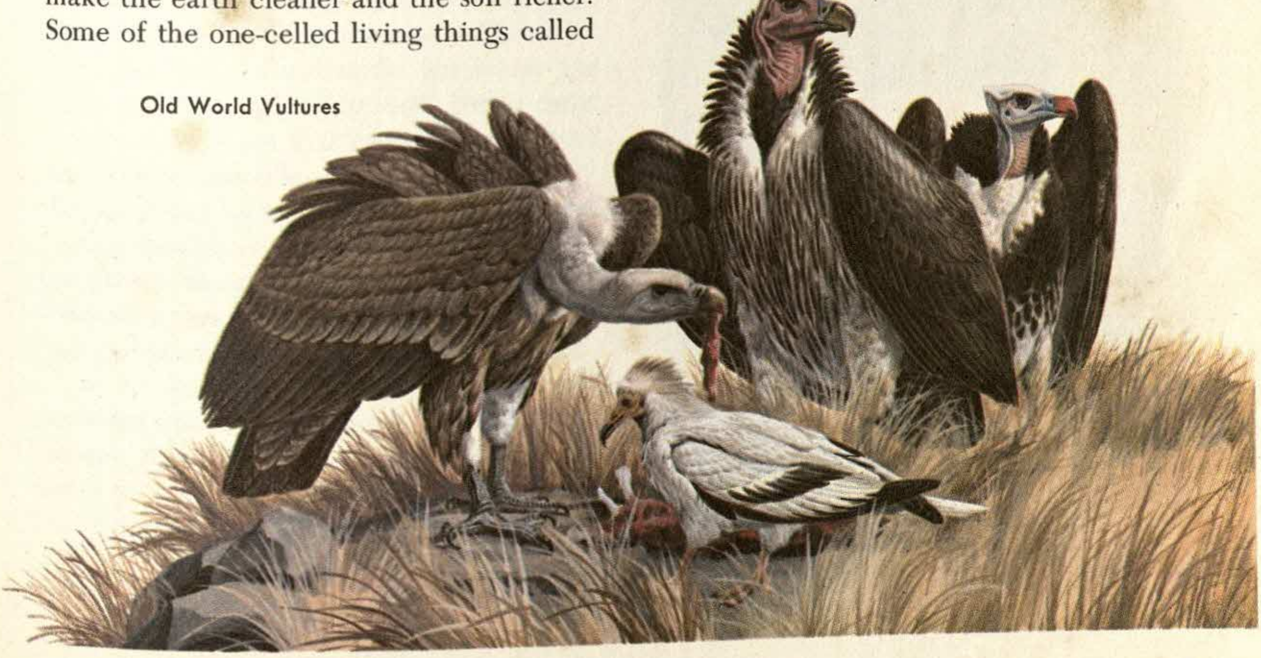
The most numerous of the cleanup brigade are the tiny bacteria. These and some of the big group of plants called fungi make plant and animal materials decay as they get food from them. By causing decay, they make the earth cleaner and the soil richer. Some of the one-celled living things called protozoa are scavengers, too. Given time enough, these small scavengers could do all the scavenger work needed. But there are bigger ones that speed up the work.

Some scavengers keep the water of lakes and streams fit for other living things. Among these are crayfish and snails. Some of them are useful in aquariums. If a tadpole in an aquarium dies and is left in the water, bacteria finally clear it away by making it decay. But as it decays, harmful materials are formed. The water, we say, becomes polluted, and the living plants and animals there may die. But a big snail or a crayfish would make short work of the dead tadpole.

There are many insect scavengers. Water scavenger beetles belong to the cleanup brigade. Dung beetles and blowflies do, too. Some insects even act as undertakers. The sexton beetle is one of these. It lays its eggs in a small animal and then buries the animal. When larvas hatch from the eggs, they eat the animal.

In most of the big groups of animals there are scavengers. The best scavengers of the ocean shores are the spiny-skinned animals. The starfish is one of them. Certain worms feed on dead plants and animals. Among the bird scavengers are the gulls and the vultures. The best-known mammal scavengers are the hyenas.

Old World Vultures



Learning in Prehistoric Times

Roman School

University of Middle Ages

Early American School

American School, 1920's

SCHOOLS A child in America may start to school when he is only two or three. For there are nursery schools and other preschool programs for very young children. From one of these he may go to kindergarten. Even if he has not gone to preschool or kindergarten, he starts in the first grade of elementary, or grade, school at about six. In most elementary schools there are eight grades. After the eighth grade come, as a rule, four grades of high school. The seventh and eighth grades; the sixth, seventh, and eighth grades; or the seventh and eighth grades and the first high-school, or ninth, grade may be in a separate school called junior high school.

By the time he finishes high school a student has usually decided what kind of work he wants to do. Suppose a boy decides that he wants to be a chemist. After high school he goes to college or to a university for four years. He may choose, instead, to go for two years to a two-year, or junior, college and spend only the last two at a senior college or university.

The young man may be able to get work as a chemist after his four college years. But for many jobs in chemistry he will need more training. He gets this in the graduate school of a university. He spends perhaps three years there. By the time he is ready for the work he wants to do he may have spent over 20 years going to school.

Not all Americans need so much schooling for doing their work. But they all need some. The states have laws saying how many years children must go to school.

One wonderful thing about schools in America is that most of them are free. All public schools are paid for through taxes. There are also private schools for those who wish them. Those who go to private schools have to pay tuition. Some of the private schools are church schools.

Almost all countries now have schools. They are not all alike. But in each one of them children are being taught to take their part in the world.

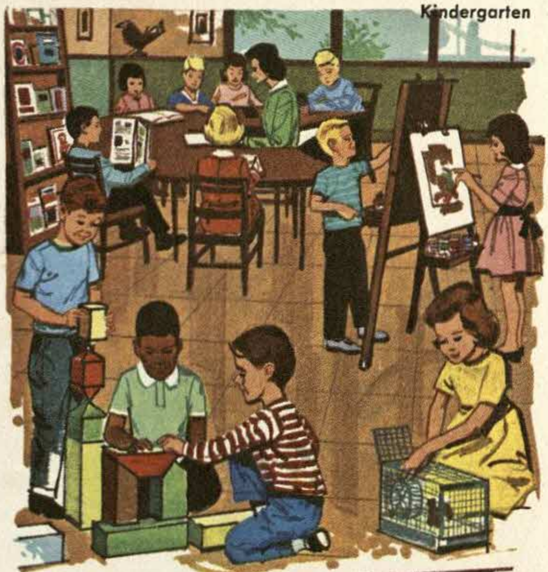
Teaching began long before there were any schools. Early man started his long climb upward by teaching others what he had learned. A cave boy did not have to start from the beginning to work out a way of killing a mammoth. His father showed him how to chip a spearhead of flint and fasten it to a long stick. He showed him how to throw the spear. Perhaps the boy in time found out how to make a better spear. He then taught his son the new way. Thus ways of doing things passed from generation to generation. So did ideas concerning the world round about.

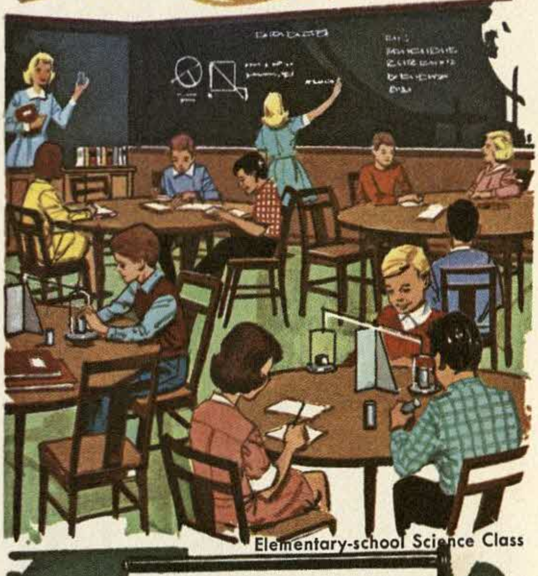
For many thousands of years all teaching was done in the family group. But after men learned to write, teaching could not all be done in this way. In ancient Egypt, for example, only a few people could write or read. Some of them made a living by reading and writing. They were called scribes. If a boy wanted to learn to read and write—perhaps he wanted to be a priest or a scribe—he had to go to a scribe to learn. Other boys who wanted to be priests or scribes might join him, and thus a school would be started.

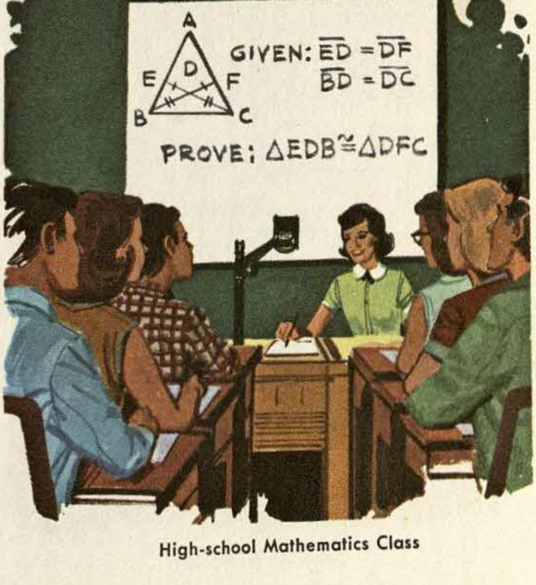
There were schools in ancient Babylonia just as there were in Egypt. Scribes would take boys to live with them to learn to be scribes. There were schools attached to the temples, too. In ruins of ancient Babylonian temples schoolrooms have been uncovered. They have in them benches where the pupils sat. In the schoolrooms, too, copybooks have been found. These copybooks were tablets of clay with the teacher's writing on one side and the writing of the pupil on the other.

China, India, Greece, Rome—all these countries had schools long ago. But the schools were not for everyone. Many poor people had to go without any schooling.

In Europe during the Middle Ages most schools were church schools. The emperor Charlemagne did much to encourage learning. He ordered the bishops to set up schools. One school was in his own palace.


Kindergarten


Elementary-school Science Class



High-school Mathematics Class

Just a little later Alfred the Great, the king of England, brought in scholars from other European countries to start a school at his court. His school, like Charlemagne's, was only for boys. Girls were not supposed to need any teaching except what their mothers could give them. They were taught to cook, sew, and take care of a home.

During the later Middle Ages universities sprang up in many cities of Europe. America owes many of her ideas about colleges and universities to Europe.

In the early days of America almost all the schools were private schools. In New England there were dame schools. In a dame school a woman, often a widow, taught young boys and girls to read. For older boys there were schools taught by schoolmasters. Some of these boys would go on to college. While it was still very young, Massachusetts Bay Colony started a college—Harvard. Other colleges, among them Yale and William and Mary, followed.

College Campus

There were few free schools before the 1800's. In 1805 Mayor DeWitt Clinton of New York set up a free school in the city. Eventually the idea of free public schools became established in the different states.

The first schools in America were held in buildings built for other purposes—in homes, churches, or government buildings. There were only benches to sit on. There were no blackboards. Of course, there were no motion-picture machines or "talking" typewriters, no basketball courts and no science laboratories. The children had few books. They had no pencils, pens, paper, scissors, or crayons. They did not even have slates. They learned from reading and from listening to what they were told.

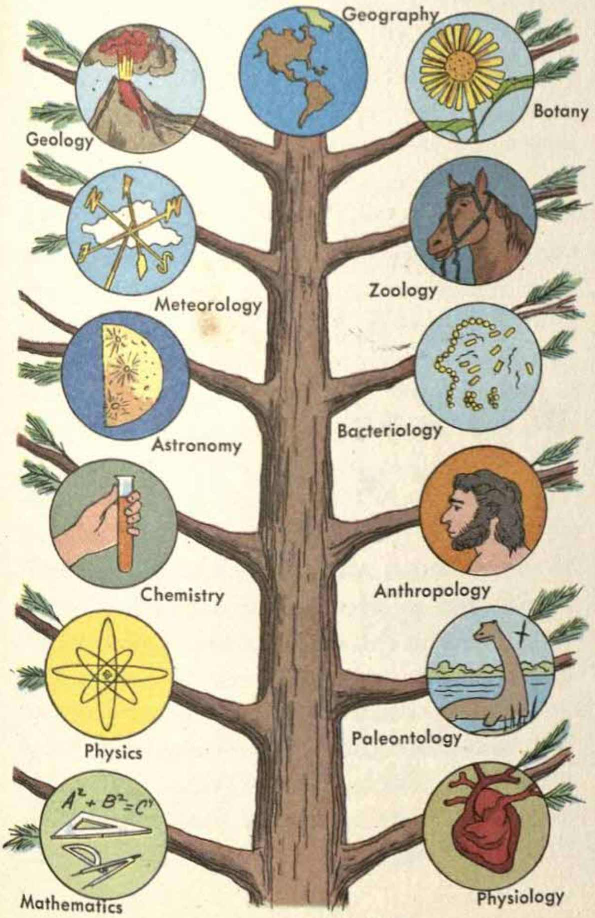
Today there are fine school buildings and wonderful materials to work with. Ways of teaching, too, have changed greatly. A child, for instance, who does not learn easily is no longer put on a stool with a dunce cap on his head. Instead, the teacher gives him extra help. Courses of study have changed. Latin, which was once considered the most important subject in high school, is now studied only by the boys and girls interested in it. Courses in such subjects as art, music, science, typing, and home economics have come in in its place.

In the public schools of the United States today there are about 44,000,000 students. More than 27,000,000 of them are in grade schools. Some are in special schools for deaf, blind, or crippled children, and for children who find it hard to learn. More than 16,000,000 boys and girls are in high schools. The enrollment in colleges and universities is over 5,000,000. Besides, there are business and trade schools, music schools, art schools, and nurses' schools. It takes a great many people to carry on the work of schools. In the grade schools and high schools alone of the United States there are 2,000,000 teachers. (See COLONIAL LIFE; GOVERNMENT; TAXES.)

SCIENCE The word "science" comes from the Latin word meaning "to know." Science is an enormous mass of knowledge about the world around us. It includes all that has been discovered about plants and animals, earth and sky, wind and weather, what things are made of, and how things work. This great body of knowledge has been built up by watching and measuring, by keeping careful records, and by carrying on specially planned experiments.

But science is not merely a big mass of knowledge. It is a great deal more. Science is also a way of thinking—of working out answers to problems.

So much has been discovered about the world we live in that no one could possibly hope to know it all. Science, therefore, has been divided up into many separate sciences. It has, we say, many branches. The science tree in the picture shows some of the most important ones. But each of these branches has branches, too.



TREE OF SCIENCE

Some sciences are called applied sciences. Applied sciences can be thought of as science put to work. Agriculture, for instance, is biology—the study of plants and animals—put to work, while engineering is the science of physics put to work.

There are still many problems for scientists to solve. Some boys and girls believe that the great days of the explorers are past. Most of the earth's land has been seen and mapped. But very little is yet known about the floor of the sea. And the exploration of outer space has just begun. Besides, all scientists are explorers. Making some new discovery about the world right around us is as truly exploring as finding a new mountain peak or getting a view of the far side of the moon. (See ANTHROPOLOGY; ASTRONOMY; BIOLOGY; BOTANY; CHEMISTRY; EXPERIMENTS; GEOLOGY; MATHEMATICS; PHYSICS; PHYSIOLOGY; PSYCHOLOGY; ZOOLOGY.)

SCOTLAND The countries of Scotland, England, Wales, and Northern Ireland together make up a larger country. That country is the United Kingdom of Great Britain and Northern Ireland. For short it is called Britain. England, the largest country in Britain, borders Scotland on the south. Scotland is next largest.

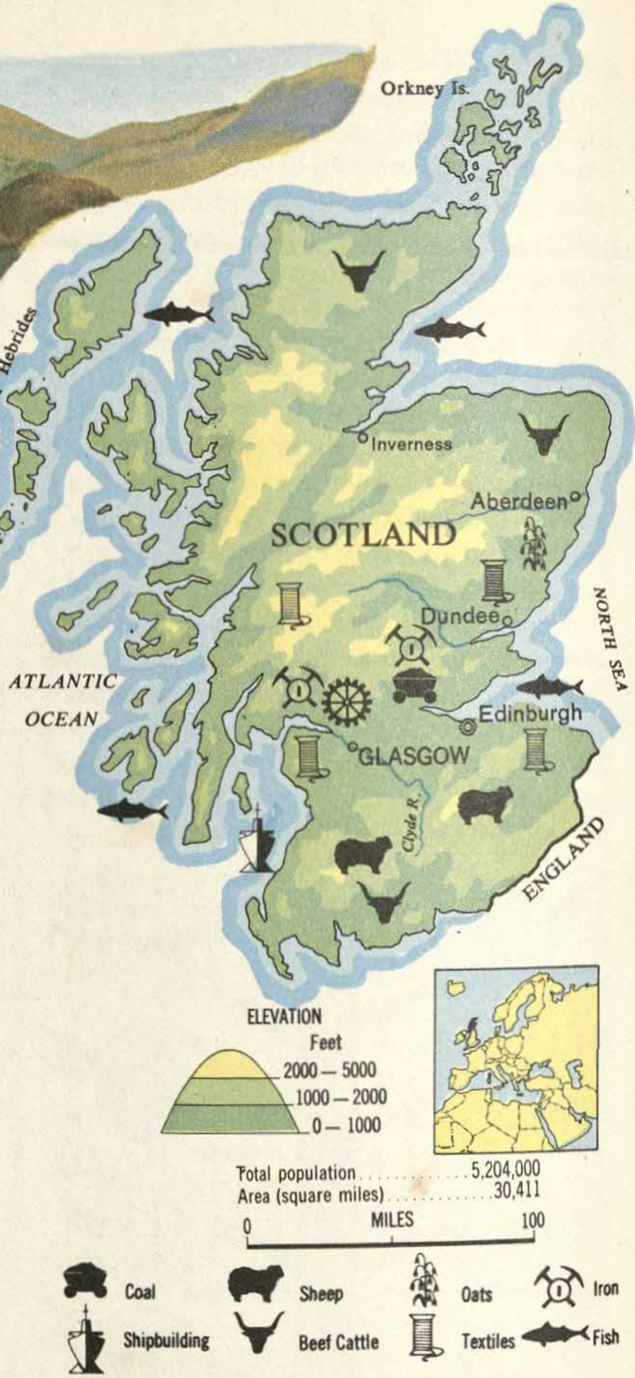
Many men in Scotland's coastal towns are fishermen. In this mountainous country less than a sixth of the land is fit for plowing. Summers are short, cool, and rainy. The chief farm crop is oats, and oatmeal is an important Scottish food. The custom of sprinkling salt instead of sugar on oatmeal reminds the Scots that many of their ancestors made only a bare living. The northern highlands take up more than half of all Scotland. There we see bare peaks, narrow forested valleys, and moors purple with heather. Good pasture is scarce. But there are many pastures in the uplands near the English border.

Between the highlands and the southern uplands, a narrow belt of fertile lowland

Bagpiper

Fishing Boats

Edinburgh



stretches across Scotland. Three-fourths of Scotland's people live in this lowland—more than 1,000,000 of them in Glasgow. Coal and iron mined near this port, and wool from the uplands are used in some of Glasgow's many factories. In shipyards nearby the famous "Queen Elizabeth" and "Queen Mary," now in America, were built. "Queen Elizabeth II" also came from them.

In the lowland there are many farms, too. Besides oats, Scottish farmers raise wheat and barley and some vegetables and small fruits. At the eastern end of the lowland is Scotland's ancient capital, Edinburgh. Edinburgh is part Old Town and part New Town. Among its centuries-old buildings are Edinburgh Castle, which looks down on the city from the top of Castle Rock, and the University of Edinburgh. The Royal Mile leads from the castle to Holyroodhouse, still a royal residence. Edinburgh has many fine shops and homes. It is famous as a center for book publishing.

Long ago, great families, or clans, lived in the northern highlands. Their chiefs lived in castles, but their clansmen lived in sod huts. The Highlanders wore kilts of woolen plaid cloth. From time to time they raided one another's land as well as lowland farms to get enough food. Today highland pastures are still used. But hunting and fishing clubs now rent much of the highland moor country. The highlands have become a holiday land. Today the Scots are a prosperous people. (See BAGPIPE; BRUCE, ROBERT.)

SCULPTURE After a snowstorm in Chicago not long ago, people passing the Art Institute saw near it a huge cat modeled in snow. The artist who made the cat was a sculptor. He had used the snow as his medium. Probably he liked the feel of snow. A sculptor usually likes the feel of his medium whether it is marble, wood, snow, or one of many other materials sculptors use.

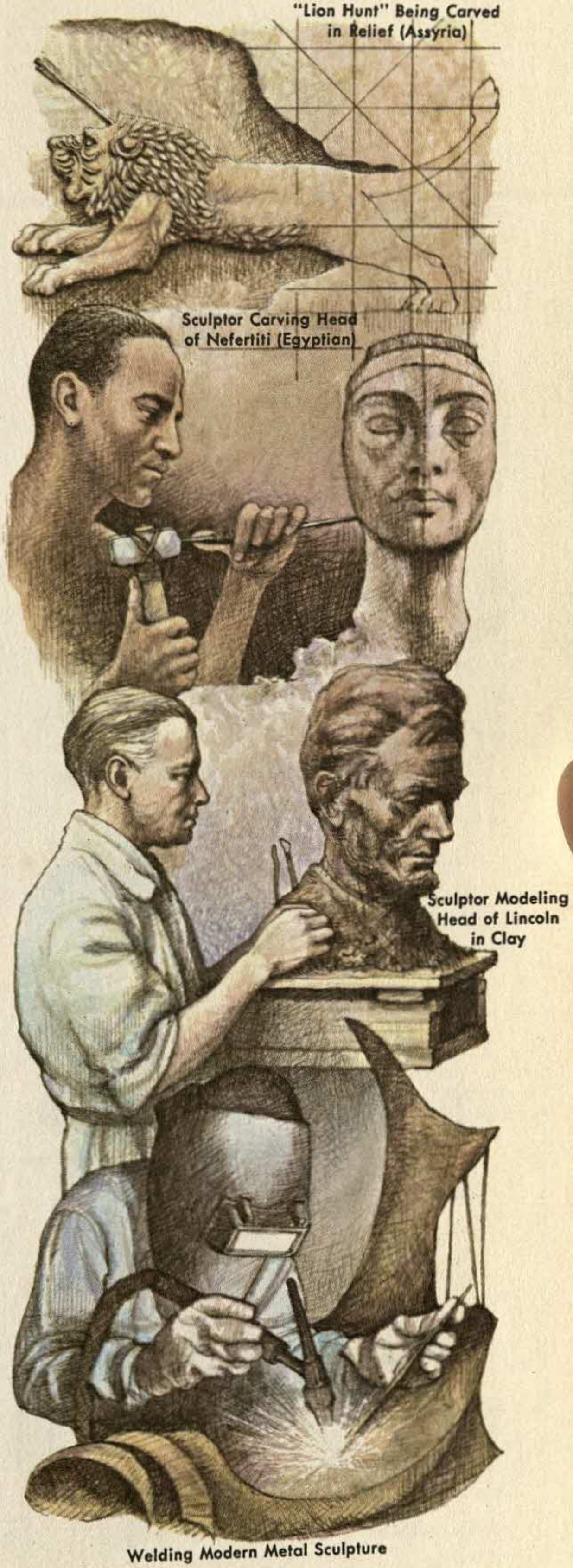
The snow cat was a piece of sculpture in the round. In relief, another kind of sculpture, pictures or designs are carved on a surface and then the remaining surface is carved back so that the picture or design stands out. There has been sculpture of both kinds for thousands of years.

Some of the statues made by the ancient Egyptians were very large. The Sphinx is one of them. It has the body of a lion and the head of a man. The head alone is 65 feet high and 14 feet across. This great statue was carved in *stone*. The Egyptians made smaller stone statues, too. The beautifully painted head of Queen Nefertiti is famous. They also made statues in wood.

Most of the best-known sculptures of the Babylonians, Assyrians, and Persians were relief sculptures. The Assyrian sculpture of the lion hunt is carved in stone.

The Greeks made wonderful statues of white marble and painted them with bright colors. The frieze of the Parthenon is a good example of their relief sculpture. They also did much sculpture in the round. No one knows the names of the sculptors of earlier civilizations. But we do know the names of some of the Greek sculptors, among them Phidias, Myron, and Praxiteles.

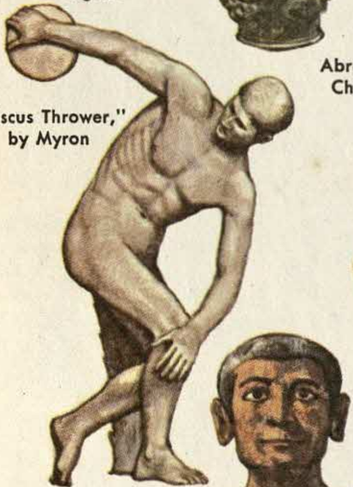
The Gothic cathedrals of the Middle Ages had stories carved on their walls. People could stand in front of a cathedral and read Bible stories told in the carved pictures. Many of the statues on the cathedrals are architectural—that is, they are part of the structure of the building. On Chartres Cathedral, for example, more-than-life-size statues serve as columns to support the arch over the main door.


"Lion Hunt" Being Carved in Relief (Assyria)
Sculptor Carving Head of Nefertiti (Egyptian)
Sculptor Modeling Head of Lincoln in Clay

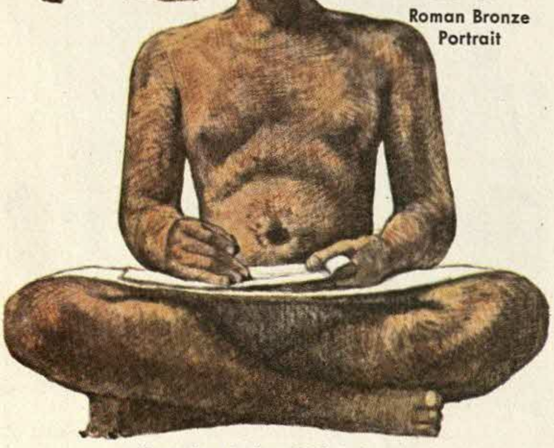
Welding Modern Metal Sculpture

Easter Island Figure

Abraham and Moses, Chartres Cathedral


"Discus Thrower," by Myron

Roman Bronze Portrait


Egyptian Scribe, 2500 B.C.

In the 15th century Italy had some of the greatest sculptors the world has ever known. Among them were Leonardo da Vinci, Ghiberti, Donatello, Verrocchio, della Robbia, and, greatest of all, Michelangelo.

In more recent times many countries have given us good sculptors. Rodin of France, Thorvaldsen of Denmark, Milles of Sweden, Meštrović of Yugoslavia, Epstein and Moore of England, Lipchitz of Latvia, Archipenko of Russia, Giacometti of Switzerland, and Picasso of Spain are a few.

Some sculptors have especially liked to design fountains. Some are especially interested in modeling animals. Some make portrait statues just as the Egyptians did.

Suppose a sculptor has been asked to make a statue 10 or 12 feet tall. It is to be for a monument. How does he go about making such a statue? Planning it is the first step. The sculptor makes a sketch of what he has in mind. A sculptor must be able to draw as well as model.

A sculptor needs to be able to do some things that are much like the work of a plumber. He must be able to cut lead pipe into pieces the right length and make joints like those a plumber makes. He needs a strong framework for his model in clay. But before he makes a big model he makes many little clay models. He decides which one he likes best. Then he builds a framework of lead pipe and wood and starts his big clay model. As a rule he models the statue, but he may carve parts of it, too. He models the general shape of the biggest parts, but when it comes to the smaller details he often carves.

If his statue is to be marble or some other kind of stone, he has much carving to do. He carves the stone into an exact copy of the clay model. He may have helpers block out the statue roughly and he himself do only the fine carving to finish it. Carving in stone is slow work. A sculptor's art takes much patience.

Making a bronze statue is very different. After the clay statue is finished, a mold is made from it. Then molten bronze is poured into the mold. Statues made of bronze are usually more detailed than those cut from stone. It is easier to pour melted metal into small places than to chip off just the right size sliver of stone.

Today much sculpture is abstract. A piece of sculpture may be just a form, not a representation of a person or animal or plant. This form may be meant to give a feeling of swiftness or of great joy or of ruggedness. It may be made of gold or brass or copper or iron. The sculptor may have to be a welder as well as an artist. The finished piece of sculpture may be very simple and smooth. It may be interesting because it is a combination of materials of different textures.

A sculptor always considers how his work is to be placed and lighted. One artist has said that a piece of sculpture should always be put on a pedestal that can be turned so that it can be seen from every direction. Poor lighting may make even a good piece of sculpture look uninteresting. If a statue is to stand out of doors where the light changes at different times of the day, the sculptor must plan a statue that will look interesting in any kind of light.

Some artists say that they like to feel a piece of sculpture with their fingers before they see it. They say that a good piece of sculpture should always make you want to feel it, not just look at it. It is the feel that sculptors have thought of chiefly in planning many of the slides and other play pieces in children's playgrounds today.

Among the interesting pieces of sculpture done by primitive peoples are the great stone figures on Easter Island in the South Pacific. Each one is carved from a single block of stone weighing many tons. Who carved them? What do they mean? How did they get where they are? Not until recently did archeologists find any answers. (See ARTS; EASTER ISLAND; FOUNTAIN; IVORY; JADE; MICHELANGELO; MODERN ART; VINCI; WOOD CARVING.)

"St. George," by Donatello (Marble)

"Figure," by Lipchitz (Bronze)

"Head," by Giacometti (Marble)

"Hand of God," by Milles (Bronze)

"Recumbent Figure," by Moore (Marble)

The sea horse can anchor itself with its tail.

SEA HORSE The sea horse is a small salt-water fish. Like other fishes, it has gills and fins. But it does not look like a fish. It swims with its head up and its tail down. Its head looks a little like a horse's head. Its tail is a little like a monkey's. The sea horse can hold itself in place by wrapping its tail around a seaweed. No other fish has this kind of tail.

The sea horse is unfishlike in still another way. The mother sea horse does not lay her eggs and then leave them as most fishes do. Instead she puts them in a pouch on the father sea horse's body. He carries them until they hatch. Then the baby fish swim away to look after themselves.

A sea horse's body is covered with small bony plates. They make a kind of outside skeleton. Many a visitor to the seashore has brought home a dried sea horse.

This little fish eats tiny crustaceans. It sucks them into its long tube mouth with lightning speed. (See FISHES.)

SEAL Most mammals live on land. The mammals called seals all live in water. Most of them live in the sea. The ancestors of the seals are thought to have been four-legged land animals. But seals have four flippers instead of legs. Flippers are much better than legs for swimming.

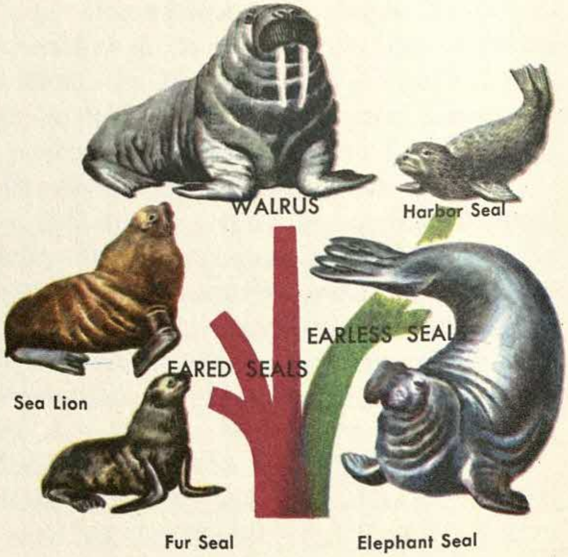
Northern fur seals are great travelers. They spend the winters roaming the ocean. In the spring they come together on the Pribilof Islands in the Bering Sea. These islands are their breeding grounds. The seals may have to swim thousands of miles to get there. The males, or bulls, reach the islands first. Each one chooses a place among the rocks for himself. Then the females, or cows, arrive to have their babies on shore. Each bull persuades as many of the cows as possible to share with him the place he chose. Every now and then, the bulls fight big battles with one another.

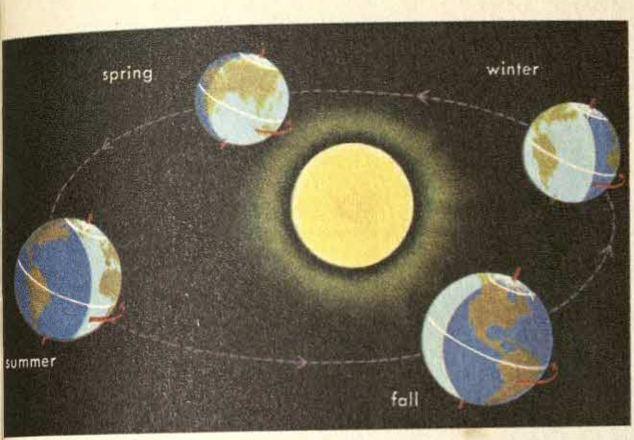
The baby seals are very small when they are born. But they eat a great deal and grow fast. They learn to swim by splashing about together in the shallow water near shore. After a few months they are big enough to swim out to sea. Fur seals used to be killed by the millions for their wonderful fur. Now governments protect them.

The familiar seals of circus acts are sea lions. They are close relatives of the fur seal. The harbor seal and the elephant seal are not. The walrus belongs to the same large group of animals as all the seals.

Elephant seals get their name from the big nose and the great size of the male. A full-grown male may be 20 feet long and weigh 4 tons. The harbor seal is much smaller. It gets its name because it is so often seen on shore.

FIN-FOOTED MAMMALS





SEASONS In many parts of the world there are four seasons every year—spring, summer, fall, and winter. Summer, of course, is the time of warm weather and winter of cold weather. And fall and spring are the in-between seasons.

Although many parts of the world have these four seasons, lands near the equator have pretty much the same temperature all year. Those lands that do have four seasons do not all have them at the same time. When lands north of the equator are having winter, lands south of the equator are having summer.

The traveling of the earth around the sun helps cause the seasons. But there is more to the story than that. As the earth travels, it spins on its axis, and its axis is tilted. It is always tilted in the same direction. The North Pole therefore is turned away from the sun for part of the yearly journey and toward it for part. The northern half of the earth has summer when the North Pole is turned toward the sun. It has winter when the North Pole is turned away from the sun. When the North Pole is tilted toward the sun, the South Pole tilts away from it. The seasons south of the equator, therefore, are the opposite of those north of the equator. They are turned around.

The earth is a little farther away from the sun in June than in December. Summers would be warmer and winters colder in the northern hemisphere if it were the other way around. (See DAY AND NIGHT; EARTH; TIME AND TIME TELLING.)

SECRET WRITING One of America's best-known short stories centers around an old piece of parchment which a man finds one day. Quite by accident he discovers part of a message in invisible ink written on the parchment. When he makes all the writing visible, the message turns out to be in cipher. After a great deal of work, he decodes the message. It leads him to a rich, hidden pirate treasure.

Edgar Allan Poe wrote this story, "The Gold Bug," more than a century ago. But it is still popular. People will probably always be interested in secret writing.

Secret writing is meant to be read only by the person or persons for whom the message is intended. Secret writing makes use of such things as invisible ink, codes, ciphers, or combinations of these.

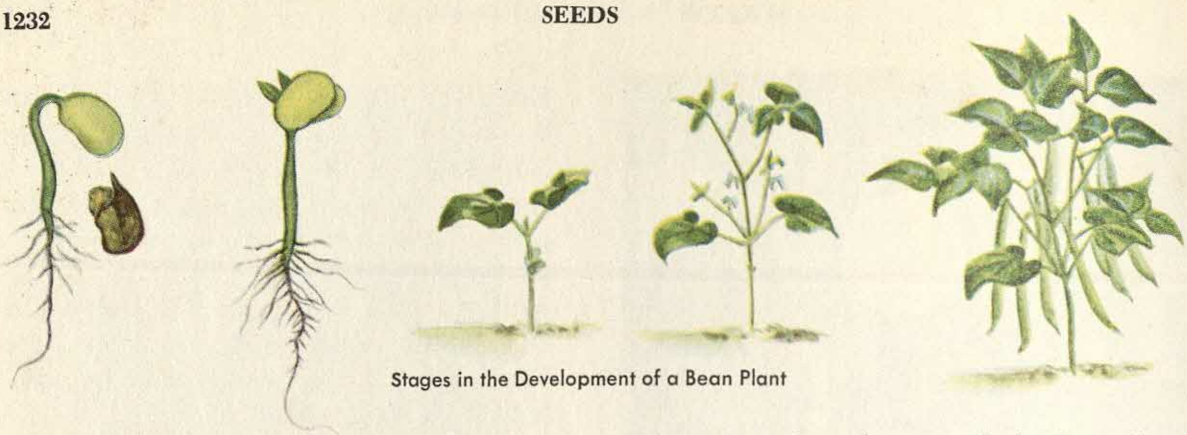
There are many things that everyone has at hand that make good invisible inks. Lemon juice, onion juice, and even milk can be used. So can water with sugar dissolved in it. Writing done with any of these "inks" will disappear as soon as it dries. It can be made to reappear permanently by heating the paper carefully.

Most people use code and cipher to mean the same thing. But to message experts there is a difference between them.

A code is a list of words, letters, or figures that stand for other words, or even whole sentences. A radio patrolman, for example, may call headquarters and say, "Signal 31." This may be code for: "An armed robbery has just occurred."

Ciphers are systems of changing the separate letters of a message. A simple example would be EGASSEM, which is MESSAGE written backwards. Other ciphers use symbols. Still others use certain letters to stand for other letters. "X," for instance, might always be used to stand for "e." Often friends work out a cipher to use in sending messages to each other.

Secret writing has very important uses. Governments use it for sending highly secret messages. (See INK.)



Stages in the Development of a Bean Plant

SEEDS More than half of all the kinds of plants in the world grow from seeds. Seeds differ greatly in size. The biggest seeds known come from palms that grow on the Seychelles Islands in the Indian Ocean. One of these palm seeds may weigh 40 pounds. Among the smallest seeds are those of orchids and witchweed. They are so tiny and light that it would take millions and millions to weigh a pound. Seeds may be different in color and shape, too. But all seeds are alike in three ways: They all have a baby plant inside. They all have some food for the baby plant. And they all have a seed coat on the outside that protects the baby plant and its food.

Although all seeds are alike in these three ways, they are not built on just the same plan. The pictures of the bean and the grains of corn on the next page show two plans. In the bean the baby plant is between two thick seed leaves filled with food. The baby plant and the two seed leaves fill all the room inside the coat. In a grain of corn there is only one seed leaf. Some of the food for the baby plant is stored around the seed leaf, not in it. A great many plants have seeds built on the bean plan. A great many, too, have seeds built on the corn plan.

Some of the tiny plants inside seeds are remarkably hardy. Quite a number of kinds of seeds are likely to sprout even if they have been stored for 15 years. More than a few kinds have been known to sprout after 100 years. And some water-lily seeds found buried deep underground in a layer of peat in China were about 1,000 years old when they sprouted!

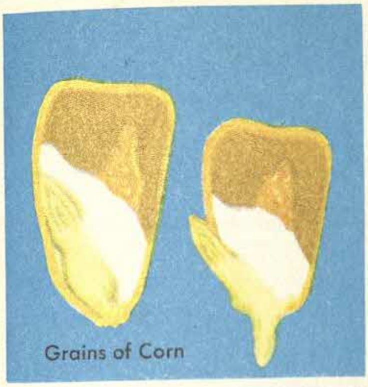
If all a plant's seeds fell close to it, not many of them would have a chance to grow. Most seeds have ways of getting themselves scattered. Some travel by land, some by water, and some by air.

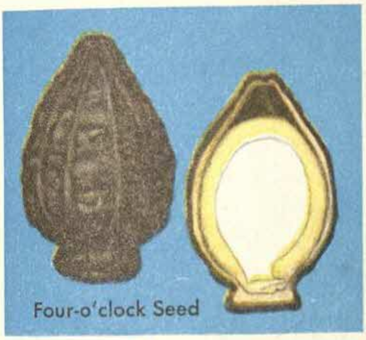
Many of the seeds that travel by air have parachutes of down. Dandelion seeds are among them. Such seeds are often called flyaways. Other seeds, like those of the elm, have wings. Most of the seeds that travel by water are light enough to float.

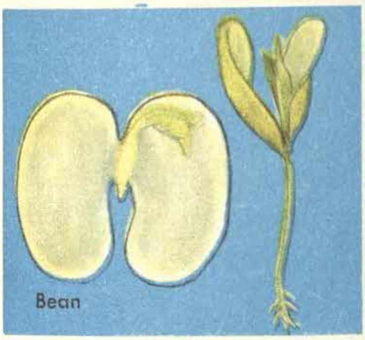
Some seeds that travel by land are hitchhikers. They may have sharp prickles that help them catch in the fur of animals. They may get rides in mud that sticks to the feet of birds and other animals. Birds often carry seeds hundreds of miles in the mud on their feet. Some seeds get themselves scattered by being in fruits birds eat. A bird may fly away with a fruit such as a cherry, eat the soft part, and drop the seed. Or it may swallow a fruit like a blackberry, seeds and all. The seeds may go through the bird's body and still be able to grow.

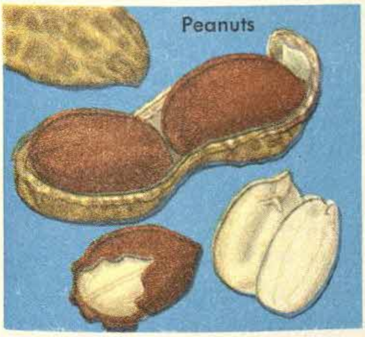
Tumbleweeds have a quite different way of scattering their seeds. The whole plant

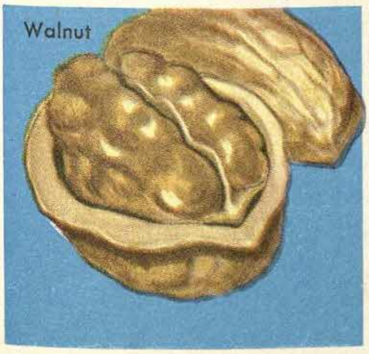
Robin with Blackberry


Grains of Corn


Four-o'clock Seed


Bean


Peanuts


Walnut

Dandelion

Sticktight

Cocklebur

Tumbleweed

American Lotus

Elm

Cattail

dries up and rolls along the ground, dropping its seeds as it goes.

Witch hazel, touch-me-not, and some other plants shoot their seeds out of their seedpods. Perhaps the best shooter is the sandbox tree, or monkeys' dinner bell, of tropical America. Some seeds coast, some crawl, some roll, and some travel about in seed holders that make good boats.

Sometimes we wish seeds did not have such good ways of getting themselves scattered. How pleasant it would be not to have to keep weeding our fields and gardens!

We eat many seeds. The food stored in seeds for the baby plants makes good food for us, too. Among the seeds we eat are beans, peas, nuts, and all the seeds we call grains. Probably the very first plants men raised were raised for their seeds. (See CEREALS; FRUITS; PLANT KINGDOM.)

SEOUL South Korea is a crowded country. A little smaller than Ohio, it has about 30,000,000 people. And more than a tenth of them live in its largest city, Seoul. Seoul is also the capital.

Seoul was the capital of all Korea for centuries. The Yi dynasty, or ruling family, made it the capital in 1392. It continued to be the capital all during the reign of that dynasty—a reign that lasted until 1910.

The city is surrounded by granite hills with bare slopes and many crags. In its early days most of the homes in the city were only one story tall. Above them towered the walls around the palace grounds and the walls that had been built to protect the city. There were eight gates in the city walls.

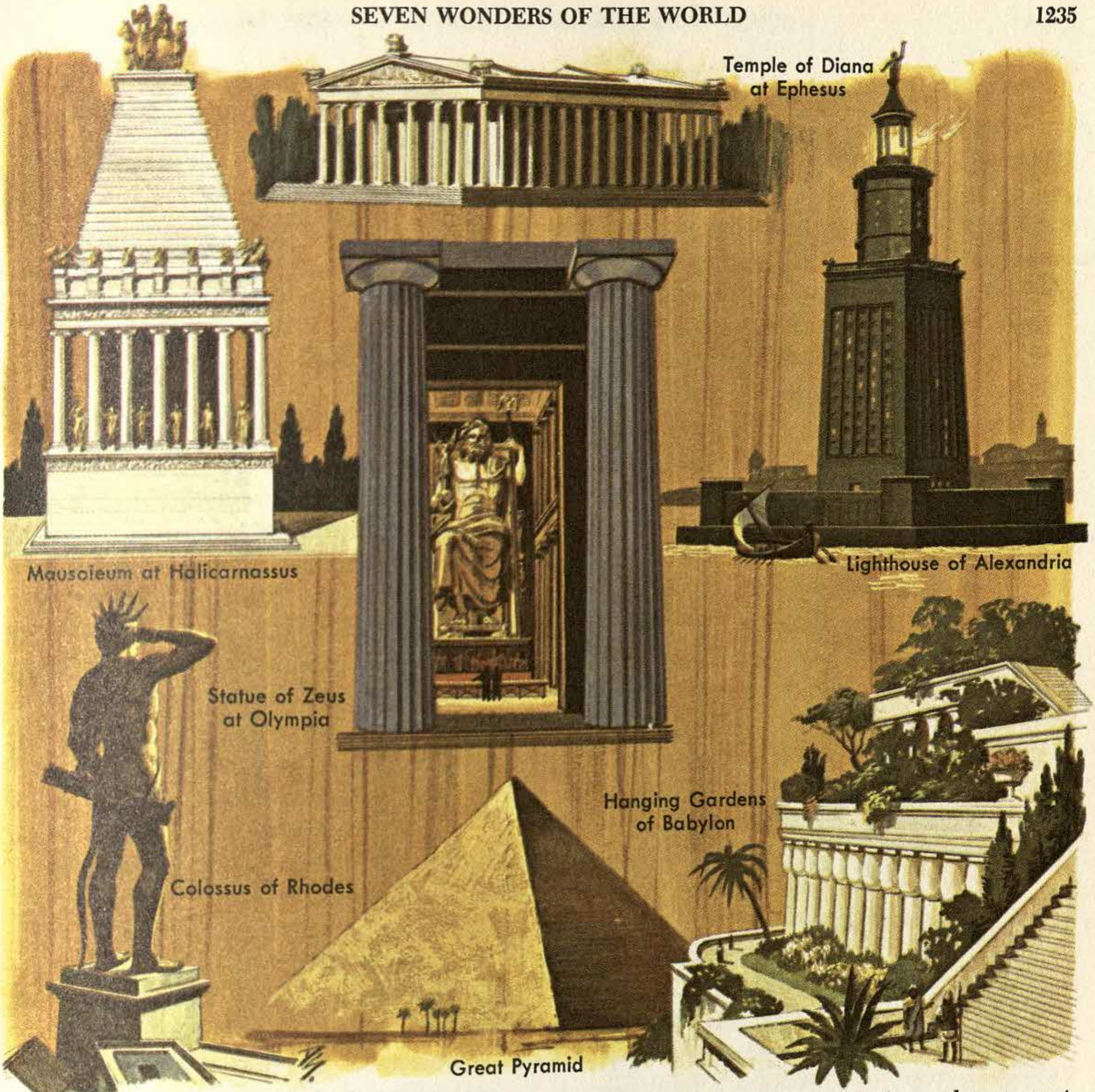
For a very long time Korea shut itself off from other countries. It was sometimes called the Hermit Kingdom. But in 1876 it opened its doors. Then Seoul began to take on a more modern look. It changed still further after Japan took over Korea in 1910. Many new buildings were built—banks, government offices, shops, churches, and schools. A railroad center was established, and streetcars appeared on the streets. All the old walls were torn down. Of them only the then useless city gates were left standing.

After World War II Korea was divided into South Korea (the Republic of Korea) and North Korea. It was then that Seoul became the capital of just South Korea. Many refugees came from North Korea to South Korea, great numbers of them to Seoul. The city spread out into suburbs.

During the Korean War, which came soon after the end of World War II, Seoul was badly damaged. Many of its most important buildings were destroyed. After that war ended in 1951, Seoul set about to rebuild itself. Today there are broad streets with fine buildings along them. Seoul is now not only South Korea's capital and largest city but also the center of all the country's activities. (See KOREA.)

SEVEN WONDERS OF THE WORLD In ancient times, long before there were great machines to help him, man showed that he was a clever builder. Some of the things built long ago were so remarkable that they are known as the Seven Wonders of the Ancient World. The seven wonders were the Pyramids of Egypt, the Hanging Gardens of Babylon, the Statue of Zeus at Olympia, the Temple of Diana, the Tomb of King Mausolus, the Colossus of Rhodes, and the Lighthouse of Alexandria.

First to be built of the seven wonders were the Great Pyramids. The largest of


Temple of Diana at Ephesus
Mausoleum at Halicarnassus
Lighthouse of Alexandria
Statue of Zeus at Olympia
Hanging Gardens of Babylon
Colossus of Rhodes
Great Pyramid

these was the tomb which King Khufu of Egypt had built for himself. It was made of more than 2 million huge blocks of limestone and granite, each weighing about 2½ tons. The pyramid was 481 feet high—as high as a 40-story building. Each side of the square base measured 755 feet. Many thousands of slaves worked to pull the big blocks to their proper places. After the blocks had all been set in place, the pyramid was covered with a facing of fine white limestone.

Although they were the first of the ancient wonders to be built, the Great Pyramids are the only one of the seven still standing. Much of the limestone facing has been removed, but the pyramids themselves are as solid as when they were built some 4,500 years ago. They are at Giza, not far from the present city of Cairo.

Twenty-five hundred years ago, the city of Babylon, in the land of the Tigris and Euphrates rivers, was famous for its magnificent Hanging Gardens. The gardens are called "hanging" because they grew high in the air on built-up terraces. Plants could grow there because of water pumped to them from the Euphrates. King Nebuchadrezzar, it is said, built the Hanging Gardens to please his queen, who missed the trees and flowers of her former home in the mountains of the land now called Iran.

Zeus was one of the Greek gods. At Olympia in Greece the famous sculptor Phidias built a statue of him some 24 centuries ago.

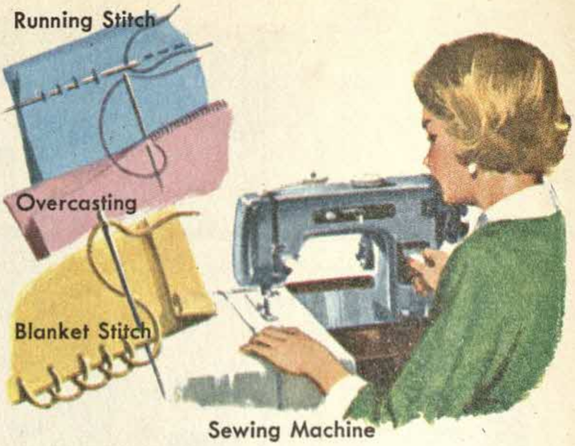
The statue was over 30 feet tall and was covered with thin sheets of ivory and gold. The eyes were jewels. This statue lasted for hundreds of years.

About 400 B.C. a marble temple was built at Ephesus, in Asia Minor, to the goddess Diana. The temple was remarkable for its great size and for the fine sculpture that decorated it. After standing for about 600 years, it was looted and badly damaged by barbarian invaders.

When Mausolus, the king of a part of Asia Minor, died, a tomb was built for him at his capital, Halicarnassus. It was not nearly as large as the Great Pyramid, but it is supposed to have been the most beautiful tomb built in ancient times. It was 140 feet high. At the top there was a statue of a chariot drawn by four prancing horses. Two figures in the chariot were supposedly King Mausolus and his queen, Artemisia. This magnificent tomb, built in 353 B.C., remained standing for over 1,500 years. It was then destroyed by an earthquake, but it was so famous that the word "mausoleum" came to be a word for tomb.

In 280 B.C. the people of Rhodes, a city on an island in the Aegean Sea, had a great bronze statue of the sun-god Helios built to celebrate a victory. The statue, called the Colossus, was over 100 feet tall. It was at the entrance to the harbor at Rhodes. The huge statue, which had taken 12 years to build, stood for only 56 years. It was destroyed by an earthquake in 224 B.C. Four hundred years later the fallen Colossus was sold by Arab raiders for scrap. The metal from it carried away on camelback was said to have made 900 or more loads.

The Lighthouse of Alexandria in Egypt guarded a harbor, too. It was a stone tower about 400 feet high. On its top bonfires burned to warn sailors that there were rocks nearby. The Lighthouse, built about 280 B.C. on an island in the harbor, lasted for more than 1,500 years. (See ALEXANDRIA; BABYLONIA; EGYPT; MYTHS AND LEGENDS; PYRAMIDS.)



SEWING Dresses, coats, suits, gloves, shoes, curtains, sheets—how hard it would be to make all such things if people had never learned to sew. Different stitches are used in making different things. But all sewing is done with needle and thread.

Sewing began so long ago that no one has any idea who invented it. Probably the very first sewing was done in the making of clothing out of animal skins.

The first needles may have been sharp stones. The person sewing simply punched holes with his stone needle. Then he pushed the grass or thin strip of leather or whatever he was using for thread through the holes. Later, people learned to make needles of bone, bronze, ivory, iron, and finally steel, and to put eyes in them. They found good fibers for thread, too.

As better needles and thread were developed, people learned to sew with skill. Ancient Egyptian tomb paintings show people wearing embroidered clothes. In museums we can see needlework from many different lands and many different periods in history.

People still take pride in doing beautiful stitching. Even little girls may have fun learning to "sew a fine seam."

Most needles of today are made of steel. Some are big; some are small. Common sewing needles come in sizes numbered 1 to 12. Thread is made of many different fibers and in many different sizes. Cotton, linen, silk, and nylon are a few of the fibers used. Thread, too, is numbered. No. 50 is much used in ordinary sewing. No. 40

is coarser. No. 10 is very coarse. No. 100 is fine. No. 200 is finer still.

In 1846 Elias Howe of Massachusetts was given the first patent on a machine that could sew. Now most sewing in the United States is done by machine. Machine sewing is much faster than hand sewing. Modern sewing machines are run by electricity. With an electric sewing machine a person does not have much to do but guide the cloth and control the speed of the machine. Early sewing machines did only straight stitching. Modern ones can make gathers, tucks, and buttonholes. They can do pleating and darning, and sew on buttons. The so-called zigzag machines can do embroidery. But sewing means measuring, cutting, and fitting as well as stitching. Sewing well takes a great deal of know-how.

When all sewing was done by hand, most of it was done at home or by tailors or dressmakers. A great deal of today's sewing is done by machine in factories.

People are not the only animals that can sew. The tailorbird sews leaves together to make a nest. The thread it uses is grass. Its bill is its needle. Tailor ants fasten leaves together with living needles. The living needles are baby ants, or larvas. The larvas, held by grown-up ants, fasten the leaves together with silk they spin. (See SAMPLER; TAILORBIRD.)

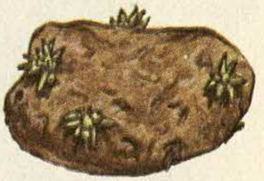
SEX The story of every scarlet tanager begins with the joining of a male cell, or sperm, from a male tanager with a female cell, or egg, in the body of a female tanager. The fertilized egg formed by this joining divides and divides until it has developed into a baby tanager ready to come out of the shell around it. Sex—maleness and femaleness—plays an important part in the reproduction of a vast number of living things. Reproduction in which it plays a part is called sexual reproduction.

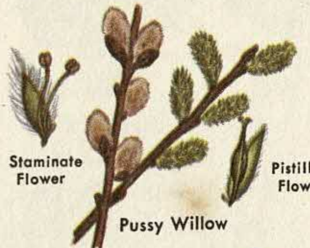
New yeast plants come mostly from buds that grow out from older plants. The sponge, a simple animal, may reproduce by simply breaking apart. New potato plants are commonly raised from buds on potatoes. Sex has no part in reproduction of these kinds. But it does have a big part in the reproduction of many plants—the baby plants in seeds, for instance, come from fertilized eggs. And sexual reproduction is the only kind found among the higher animals.

The male cells of seed plants are found in pollen. The female cells are in ovules. Most seed plants have flowers. Stamens in their flowers produce the pollen. Pistils in their flowers contain the ovules. Many plants have both stamens and pistils in all their flowers. Other plants have stamens in some flowers and pistils in others.

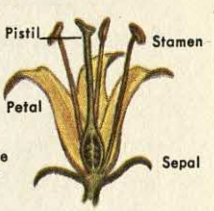
A single white-lipped snail produces both eggs and sperms. But among animals the sexes, as a rule, are separate. They may look quite different. They may, for instance, differ in size or color. (See HEREDITY.)

Yeast Budding

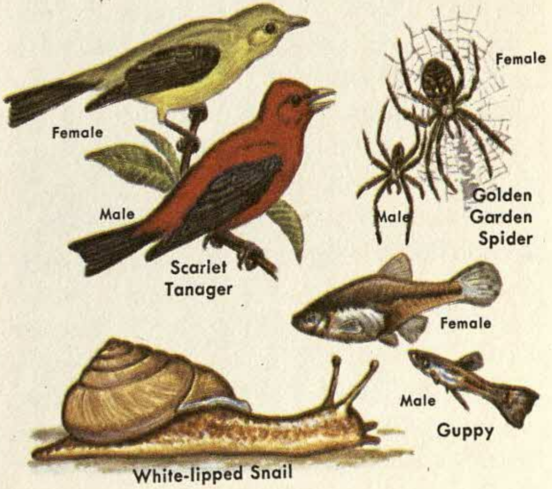

Potato Sprouting



Pussy Willow



Complete Flower



Scarlet Tanager

Guppy

White-lipped Snail

Shakespeare at Rehearsal of Romeo and Juliet

SHAKESPEARE, WILLIAM (1564–1616) England's greatest poet, William Shakespeare, was born at Stratford-on-Avon, a market town 91 miles northwest of London. He was born during the reign of famous Queen Elizabeth I.

Shakespeare was earning his own living by the time he was 18. He was not yet 19 when he married Anne Hathaway. They had three children—Susanna, Judith, and Hamnet. Judith and Hamnet were twins.

Not much is known about what Shakespeare did in the years just after his marriage. Some accounts say that he taught school in the country for a while. Some say that he worked for his father, who was a glovemaker. A few years later he appeared in London as an actor and writer of plays. His plays were written in poetry.

In 1592 bubonic plague, a terrible disease, swept over London. For about two years all London theaters were closed. During that time Shakespeare began to write poems. Besides writing some long poems, he wrote more than 100 sonnets. A sonnet is a 14-line poem which has a certain regular pattern and rhyme.

When the plague was over, the playhouses were opened again. New companies of actors were formed and Shakespeare began to spend most of his time writing plays. He became a part-owner in the company for which he wrote. This company, known as the Lord Chamberlain's Men, often put on a play to entertain the royal household. Shakespeare prospered.

Shakespeare wrote some of his plays about early kings of England. *Henry V* and *Richard III* are two of these plays. They helped the English people to understand the history of their own country.

Besides his historical plays Shakespeare wrote both comedies and tragedies. *Romeo and Juliet* is one of the most famous of his tragedies. It is the story of two young lovers whose families hate each other. The play ends with the deaths of the lovers. Other tragedies include *Hamlet, Macbeth,* and *Othello.* Among his comedies are *A Midsummer Night's Dream, The Taming of the Shrew,* and *The Merchant of Venice.*

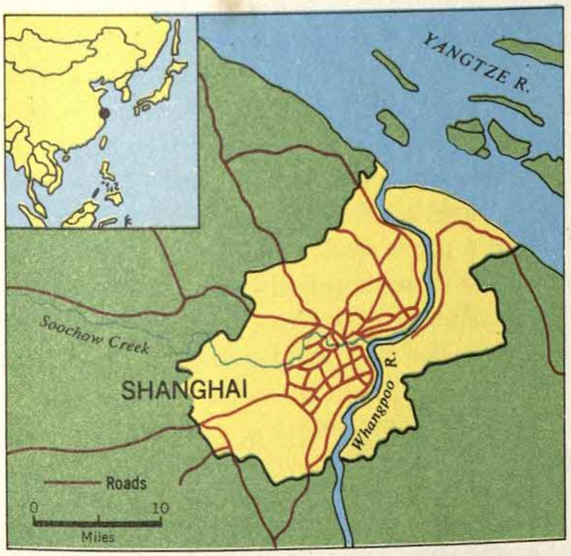
Shakespeare borrowed from other writers some of the stories for his plays. But his way of telling the stories was his own.

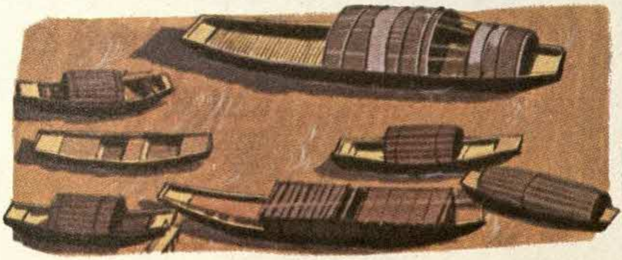
At the height of his success Shakespeare returned to Stratford. There he died on his 52nd birthday. He is buried in Stratford. Thousands of people visit his birthplace and grave each year.

His plays, still popular today, have been translated into dozens of languages. Many people think that *Hamlet* is his greatest play. Even now, more than 350 years after Shakespeare died, the ambition of many actors is to be a great Hamlet. (See ELIZABETH I; ENGLISH WRITERS; RENAISSANCE; THEATER.)

SHANGHAI The Chinese seaport Shanghai is a city of over ten million people. It is the largest city in the world and one of the busiest ports. Its name means "up from the sea." The name is a good one. Shanghai lies on mud flats 14 miles up the little Whangpoo River, which joins the mighty Yangtze River. The spot was not a very good one for building a city. It was hard to get fresh water, good drainage, and firm foundations for buildings.

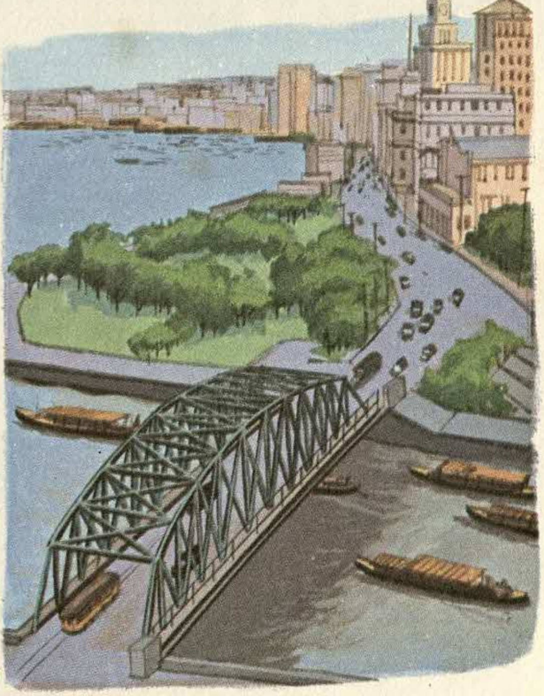
Shanghai, however, has a big point in its favor. It is the door to the long, broad Yangtze Valley. In the farm villages and cities of this vast area live over 200,000,000 people. Two hundred million people furnish many customers and supply many materials for merchants and factories. These customers can be reached cheaply by steamers, oil tankers, and small rivercraft. Bus lines and railroads feed into the city. Shanghai has regular air service to all the large cities of China as well as to important cities of other Communist countries.

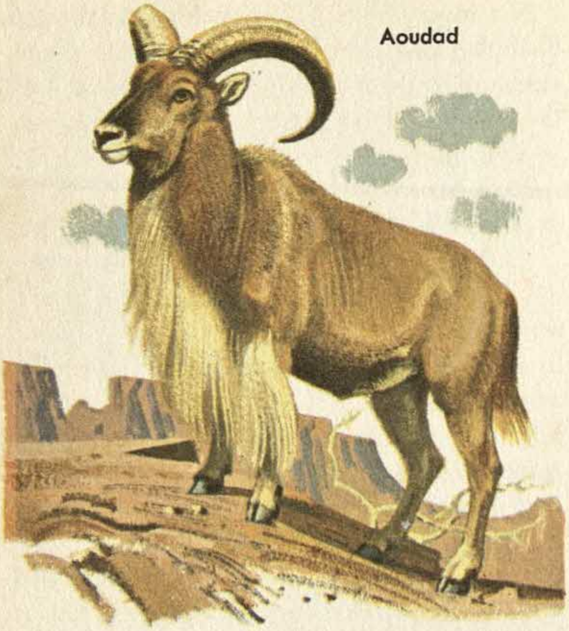




Not much more than a hundred years ago Shanghai was only a small fishing village enclosed by a wall. By World War II half the trade of China passed through Shanghai. It also had nearly half the country's big new factories. Most of China's printing was done in the city.

The growth of Shanghai began with the coming of British, American, and French merchants during the past century. These foreigners built up the section of the city which fronts the Whangpoo. This section has handsome boulevards lined with hotels, banks, air-conditioned department stores and movies, tall office buildings, and great warehouses near the harbor. The older Chinese section has narrow streets crowded with small shops bearing brightly painted "up-and-down" signs. Shanghai now has many factories, among them textile mills, cement and chemical plants, shipyards, steel mills, and paper, glass, and plastics plants. There are schools and colleges for Chinese young people. Shanghai used to be a "double city." Now the foreigners have gone and all of Shanghai is a Chinese city. (See CHINA; CITIES.)




Aoudad

SHEEP For tens of centuries shepherds and their flocks have been an important part of the life of many lands. There are still, especially in regions in Asia, shepherds and flocks. But most of the sheep of today are on farms and ranches.

Sheep were tamed in prehistoric times. They furnished meat, milk, and skins. Early man found, too, that live sheep could be sheared and their wool woven into cloth.

There are now many breeds of sheep. Some are raised chiefly for their wool. The world uses more than 2½ million tons of wool a year. Some breeds furnish fur. And some are raised mostly for meat. The meat from sheep less than a year old is called lamb, that from older sheep, mutton.

The Hampshire, Cheviot, and Merino are among the breeds raised in the United States. The Hampshire and Cheviot are raised chiefly for meat. Their wool is only a few inches long. The Merino is raised for its wool, which is several inches long and finer than that of most other breeds.

The Karakul is a breed common in parts of Asia. The skins of lambs of this breed are made into the furs called caracul, Persian lamb, and broadtail.

Many of the sheep raised in Asia and northern Africa have long, heavy tails. They are known as fat-tailed sheep because they store a great deal of fat in their tails. The Karakul is a fat-tailed breed.

Fat-tailed sheep can be raised where it is dry and barren for long periods. At

Hampshire

Cheviot Lamb

Karakul

Merino

such times the animals live on the stored tail fat. Fat from the tails is made into a kind of butter when the sheep are killed.

There are still wild sheep. They are found in mountainous regions. Among them are the mouflon of Corsica and Sardinia, the Marco Polo sheep of central Asia, and the bighorn of the Rockies. The aoudad lives in northern Africa. Another name for it is Barbary sheep. (See CHEESE; DOMESTICATED ANIMALS; WOOL.)

SHELLFISH A great many of the animals that live in water have no backbones. A great many of these water animals without backbones do have shells or hard coverings much like shells. They are often called shellfish. The name is only half good, for shellfish are not really fish. All true fishes have backbones.

Clams, snails that live in water, and lobsters are shellfish. Clams have two shells hinged together that can open and close. Snails have only one shell. The hard covering of a lobster is not a true shell, but the lobster is called a shellfish. There are many other shellfish.

Shellfish of many kinds are good to eat. Americans eat tons of clams, oysters, shrimps, lobsters, and scallops every year. (See CRUSTACEANS; MOLLUSKS.)

SHELLS Many kinds of animals without backbones have shells. Most of these animals live in water. They build their shells out of lime from the water. An animal's shell grows as the animal grows.

The shells of some animals are all in one piece. The shells of others are made of two parts hinged together.

Many of the one-piece shells come from snails. Snail shells are probably the shells people know best. There are water snails and land snails. All snail shells are twisted. Some of them are twisted in one direction, some in the opposite direction. Because of the way they are twisted, snail shells are called right-handed or left-handed. Most are right-handed. All but two or three of the one-piece shells in the pictures on the next page are easy to pick out. It may not be easy, however, to see that the keyhole limpet, the bleeding tooth, and the abalone shells are one-piece shells, too. One of the most beautiful of all one-piece shells is made by the chambered nautilus, which is not a snail. It is, instead, a cousin of the shell-less octopus.

Among the biggest of the one-piece shells is that of the queen conch. This shell has a pearly pink lining. When a person holds a queen conch shell to his ear, he hears a roar like the roar of the sea. Many people think that they are really hearing the sea, but of course they are not. The least little sound outside will be magnified into a roar inside the big twisted shell.

Oysters, mussels, scallops, and clams are among the animals with two-piece shells. The animals with two-piece shells are often called bivalves.

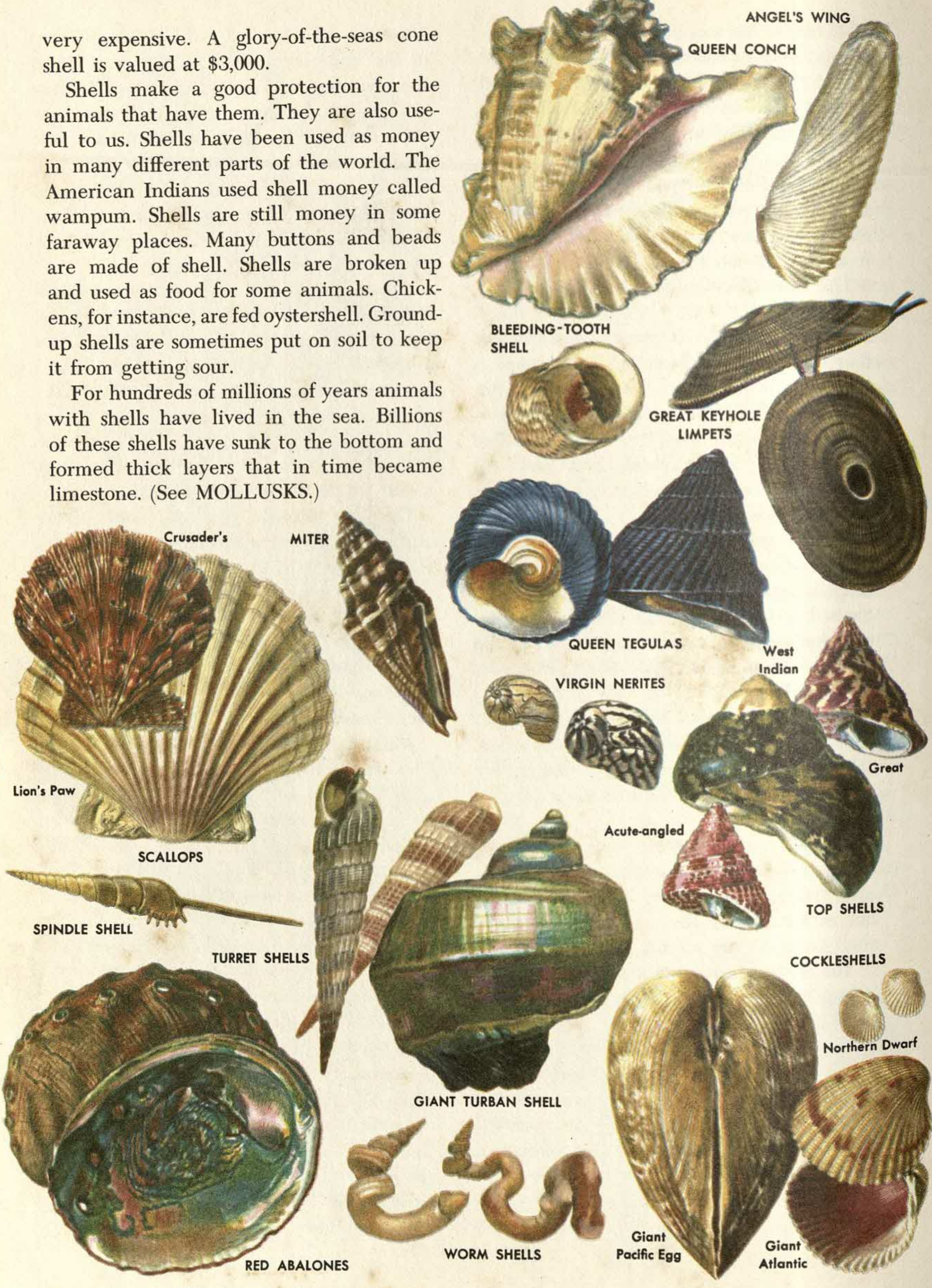
The only bivalve shells among the shells pictured are the scallops, the cockleshells, and the angel's wing. Only one part of the angel's wing and of each of the scallop shells shows.

Many people collect shells for a hobby. The names they give the shells may have nothing to do with the animals that made them. Instead, the names tell how the shells look. There is no way of telling from the name angel's wing, for instance, that the animal that makes this beautiful shell is really a kind of clam.

It is possible to have an interesting shell collection in a small space, for some shells are no bigger than the head of a pin. But a collection of all the kinds of shells in the world would take up an enormous amount of space. There are about 100,000 known kinds of animals with shells, and the shells of some bivalves grow to be even larger than the shell of the queen conch. The shell of the giant clam may be more than a yard across. Besides, since some shells are extremely rare, such a collection would be very expensive. A glory-of-the-seas cone shell is valued at $3,000.

Shells make a good protection for the animals that have them. They are also useful to us. Shells have been used as money in many different parts of the world. The American Indians used shell money called wampum. Shells are still money in some faraway places. Many buttons and beads are made of shell. Shells are broken up and used as food for some animals. Chickens, for instance, are fed oystershell. Ground-up shells are sometimes put on soil to keep it from getting sour.

For hundreds of millions of years animals with shells have lived in the sea. Billions of these shells have sunk to the bottom and formed thick layers that in time became limestone. (See MOLLUSKS.)



SHIPS All boats may be called ships and all ships may be called boats. But usually the word "boat" is saved for a small vessel while "ship" is used for one big enough to go to sea.

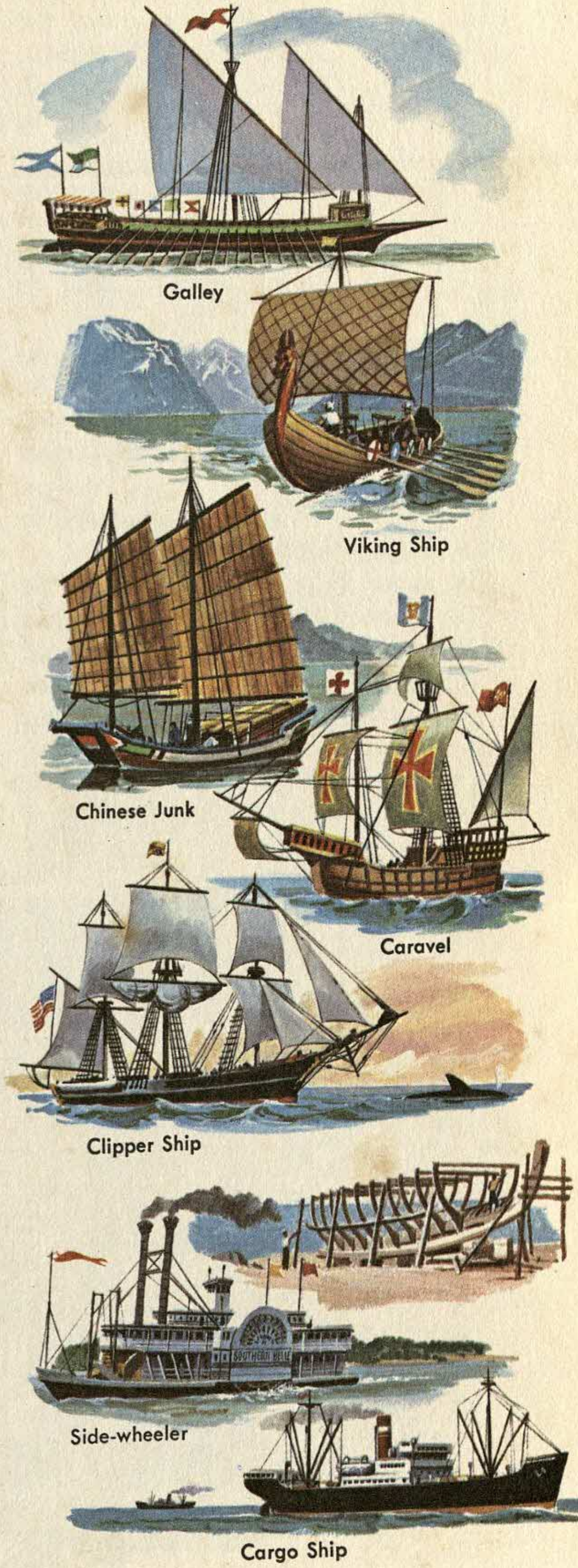
A big passenger ship, or ocean liner, is a great deal like a city hotel. It has several floors called decks. On all the upper floors there are bedrooms called staterooms or cabins. Elevators carry passengers from deck to deck. Besides the bedrooms there are dining rooms, beauty shops, barber shops, stores, and lounges. Many liners have gymnasiums, a theater, a swimming pool, and a hospital. The rooms may be air-conditioned. They all have electric lights. Many have telephones.

A liner is driven through the water by giant bronze propellers. These propellers are turned by steam turbines, diesel engines, gas turbines, or electric motors. A rudder at the back of the ship guides it. The ship is controlled from the wheelhouse, which is at the front of the very top deck. Here the captain gives his orders. Here the helmsman steers the big ship. And here is the automatic steering wheel that keeps a ship on its course out at sea.

The captain has much help in sailing his ship. Some of it comes from wonderful instruments—compasses, amazingly accurate clocks, and weather instruments. Radio, radar, and sonar help him find out easily how far he is from shore and from other vessels and how deep the water is.

Of course, a big liner weighs thousands of tons. It can float because of the way it is built. Much of the ship is filled with air. Air is so much lighter than water that the whole boat, even with its great engines and its passengers, weighs much less than the water that would take up the same space.

The largest ocean liner ever built, the "Queen Elizabeth," was retired in 1968 and was bought to serve as a resort hotel in Florida. It is docked at Port Everglades, just south of Fort Lauderdale. The great ship is over 1,000 feet long, longer than



Galley

Viking Ship

Chinese Junk

Caravel

Clipper Ship

Side-wheeler

Cargo Ship

most city blocks. The fastest liner is the "United States." Its first trip across the Atlantic took 3 days, 10 hours, 40 minutes. To make this fast time it traveled 35.59 nautical miles an hour. A nautical mile is a little longer than a land mile.

Before the days of steam engines ships were driven by oars or sails. As late as 1850 the fastest ships were sailing vessels. Clipper ships could cross the Atlantic in about two weeks.

Today many of our big ships are naval vessels or cargo ships or oil tankers. The aircraft carriers of the U.S. Navy are among the largest ships in the world. The largest ships of all, however, are the oil tankers. Some of these huge vessels weigh well over 300,000 tons when they are loaded.

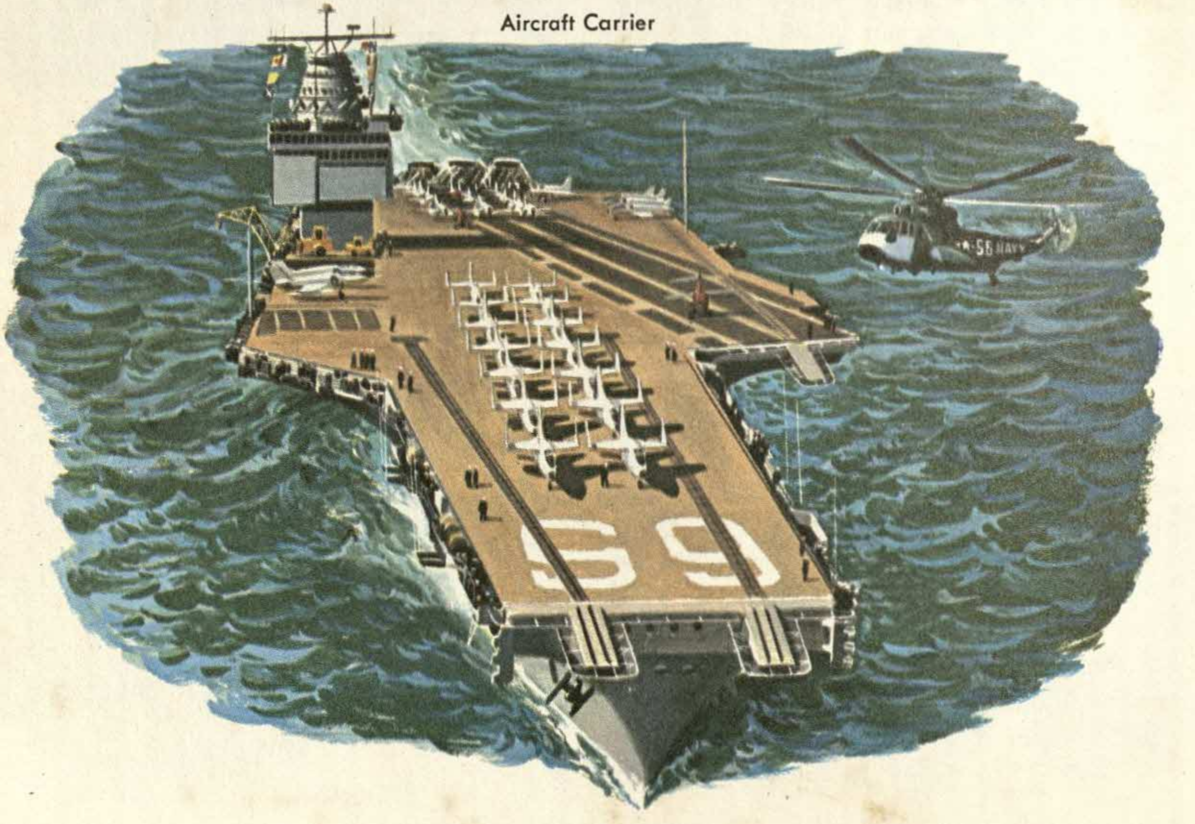
For many, many years ships were the only means of crossing oceans. Now there are airplanes. But ships can carry much bigger and heavier loads than airplanes. Ships of many kinds will keep on sailing the seven seas. (See ATOMS; BOATS; COMPASS, MAGNETIC; ENGINES, HEAT; GYROSCOPE; NAVY; SUBMARINES.)

SHOES Many people think it is fun on a warm summer day to walk barefoot through grass or on bare sand. But no one thinks it is fun to walk barefoot in snow or over rough stones. It is not surprising that people learned to make shoes for themselves before they learned to keep records.

Since there is no record of the earliest shoes, we can only guess what they were made of and how they looked. Perhaps they were made of animal skin. Perhaps instead they were made of matted grass or of flat pieces of wood. Probably they were fastened on with strips of skin or with strands of grass. Many of our shoes today are made of animal skin—the tanned skin we call leather. But the upper parts of shoes may be made of cotton, nylon, plastic, silk, straw, or linen. And the soles may be made of rubber or a man-made material called composition. The heels may be made of rubber, wood, plastic, or composition.

At first shoes were only for protection. But in time they were for decoration, too. They also showed the rank of the wearer. Just for protection no one would ever have

Aircraft Carrier



made shoes with toes so long that they had to be chained up to the knees. No one would ever have made shoes with very high heels, with toes six inches broad, or with big buckles glistening with jewels. The pictures show a very few of the many kinds of shoes that have been worn in various places at one time or another.

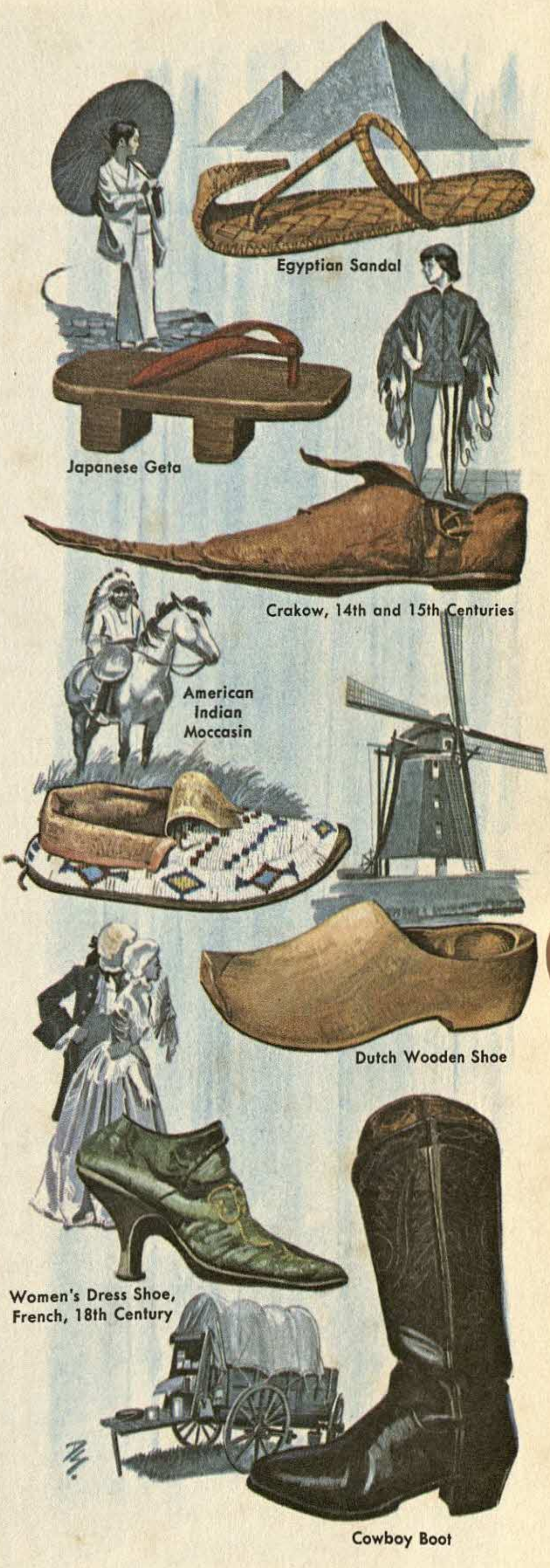
Today the two shoes in a pair of shoes are not alike. One is for the left foot and the other for the right foot. But having the two shoes different is not a very old idea. It goes back only about 150 years.

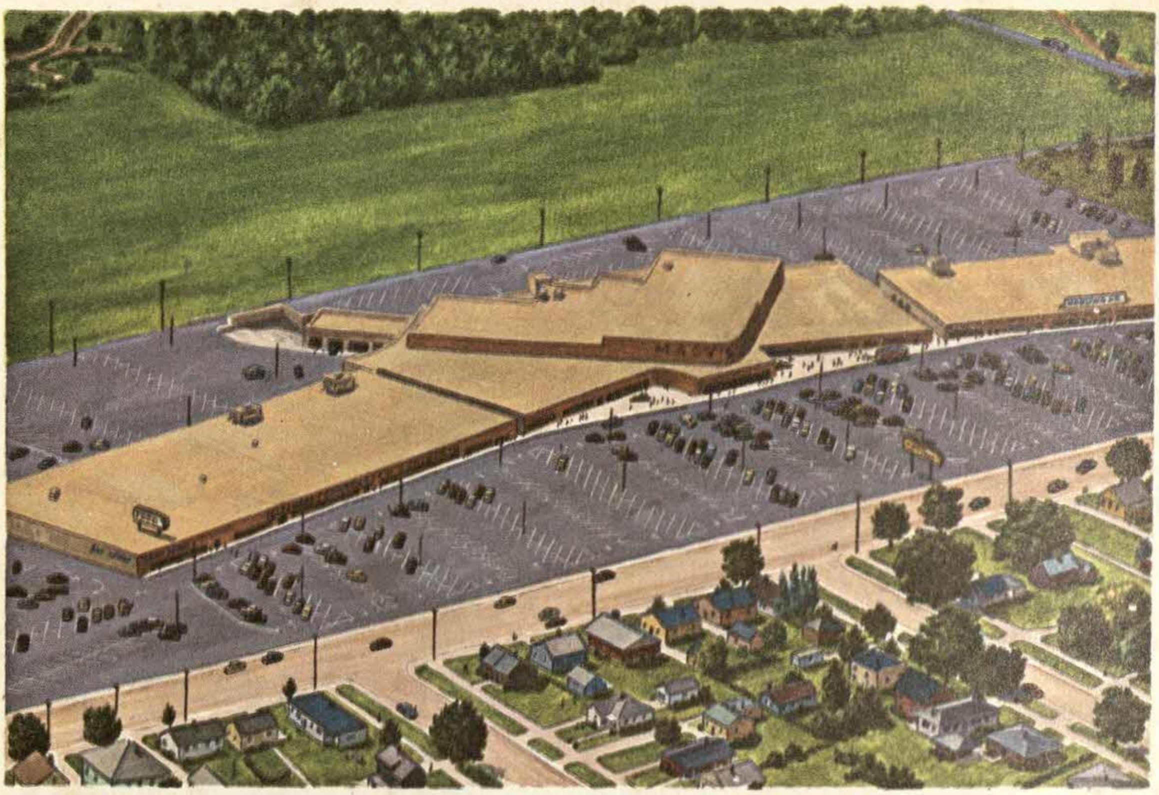
Of course, for a very long time all shoes were made by hand. In the beginning every family made its own shoes. But as villages grew up some people became shoemakers for other people. In Europe during the Middle Ages the shoemakers were very important members of the groups in which they lived. When the "Mayflower" made its second voyage to America, it brought the first shoemaker, or cobbler, to the colonies. The people in Plymouth were very glad to have a cobbler join the settlement.

There are still shoemakers who make shoes partly by hand. But most shoes are now made by machine in factories. Many of the more than 150 machines needed for making a pair of shoes are sewing machines.

In a shoe factory a leather shoe goes through eight different departments. They are the cutting room; stitching, or fitting, room; sole-leather room; lasting room, where the shoes are shaped to fit; bottoming room, where the outer soles are fastened on; making room, where the heels are put in place; finishing room; and packing room.

Shoemaking today is a big business. The stores of the United States sell almost a billion pairs of shoes a year. The United States makes more shoes than any other country in the world. More than a fourth of all the shoes made anywhere are made there. Besides the shoes made in its factories, the country imports over 150 million pairs a year, mostly from the United Kingdom, Italy, and Japan. (See LEATHER.)





SHOPPING CENTERS An important part of the story of the 20th century has been the fast growth of cities. In more than a few countries over half the people now live in cities. Cities have grown in two ways—up and out. The building of tall apartments lets a great many people live in a small space. And, of course, the spreading outward of a city lets more people live in it. Most of the big cities of today have spread beyond their boundaries into suburbs.

The heart of most cities is made up largely of stores, banks, hotels, restaurants, theaters, and offices. As cities spread out, the people on the outskirts found themselves far away from these centers. The distance from them was a problem even for people with cars, for most of today's cities began before the days of automobiles, and no one thought of space for parking. Cities have built downtown garages for parking and have cleared areas to make pay parking lots, but often a driver has to park blocks from where he wants to be. Besides, paying to park can be expensive.

The answer to the problem has been the building in the outskirts of cities of shopping centers with parking space around them. A shopping center usually has at least a dozen kinds of business establishments. One center eight miles from the heart of Chicago, for instance, has these: a drugstore, a hosiery shop, a travel bureau, a notions store, a savings bank, two women's-wear stores, a bookshop, a record shop, a men's-wear store, a shoe shop, a candy store, a currency exchange, a dry cleaner, a furniture shop, a hamburger grill, an optometrist, a bakery, and a supermarket. Around it is parking space for 500 cars.

Some shopping centers are more elaborate. They may have branches of the big downtown department stores. They may have restaurants and theaters, too. Many have trees and flowers. In some cases the walks are covered so that the temperature inside and outside can be kept the same throughout the year. It is hard to drive along a main highway into an American city today without seeing at least one shopping center.

SHRUBS Trees have woody stems. So do many other plants. Some plants with woody stems are vines. Some are shrubs. It is easy to tell a vine from a tree; vines climb. It is not easy to tell a shrub from a tree, especially from a young tree. Full-grown shrubs are smaller than full-grown trees, and their stems are thinner. A shrub as a rule has more than one stem, a tree only one. And shrubs branch closer to the ground than do most trees.

Some shrubs are evergreen like some trees. Other shrubs drop all their leaves in the fall just as many of our trees do.

Raspberry plants are shrubs. So are the plants that bear blackberries, gooseberries, and currants. We raise many shrubs for their fruit. We often call shrubs bushes.

Rows of shrubs may be used as fences. A shrub fence is called a hedge.

A great many kinds of shrubs are raised because they are beautiful. Some have beautiful flowers. Some have bright berries. We like some for their leaves. Some can be trimmed into interesting and unusual shapes. The shrubs we raise for their beauty are called ornamental shrubs. Roses, lilacs, spirea, hydrangea, honeysuckle, yew, and rhododendron are among the most widely planted of these ornamental shrubs. (See HERBS; TREES; VINES.)

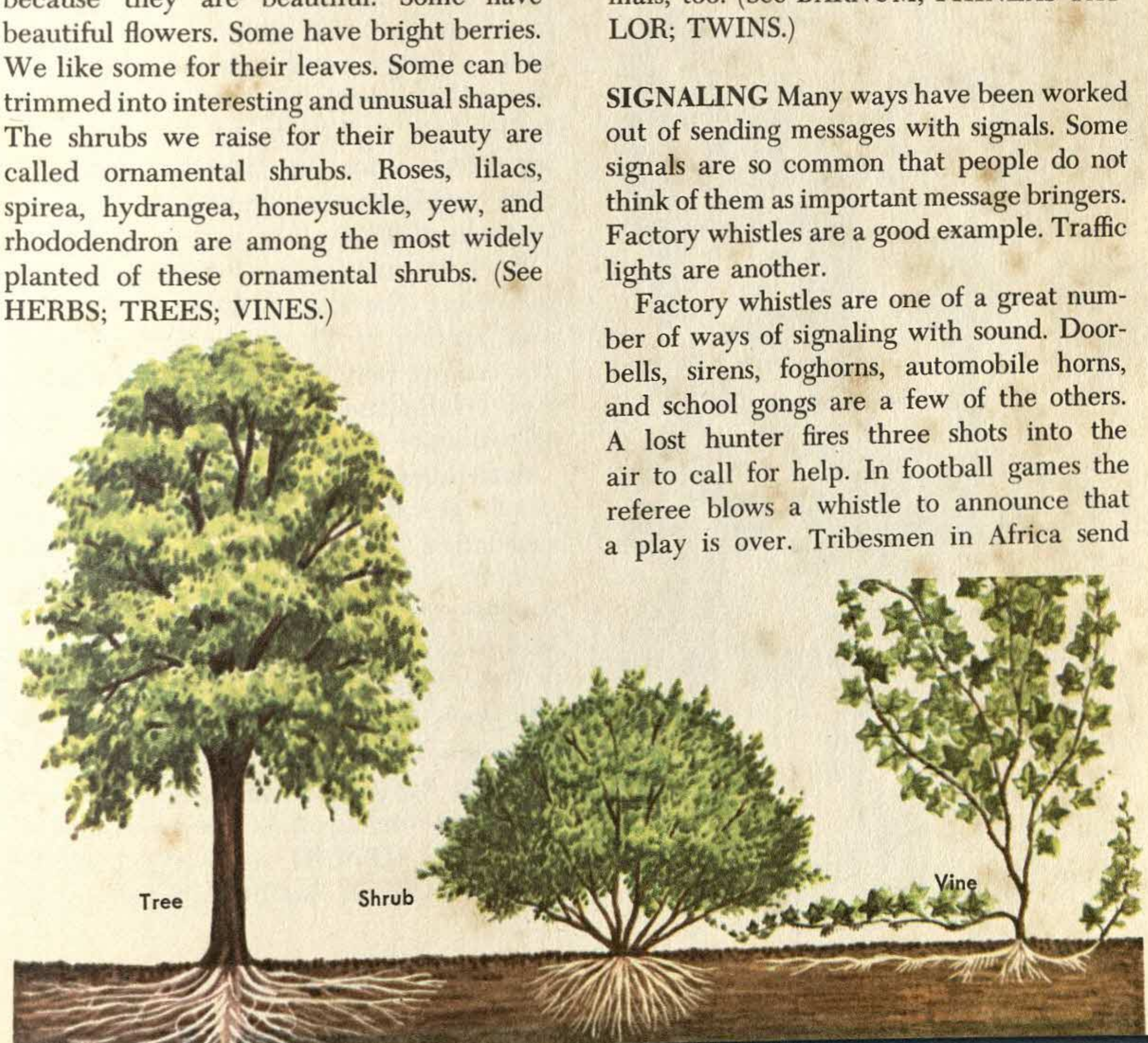
SIAMESE TWINS In 1811 Chang and Eng, two boys, were born in Siam. Their father was Chinese. Their mother was half Chinese and half Siamese. Chang and Eng were twins, but they were not like most twins. They were joined together at the chest in such a way that they shared their blood with one another.

The doctors said that Chang and Eng could not be separated. At least one of them would be sure to die if they were. So they remained joined all their lives. They lived to be 63 years old! P. T. Barnum, the circus man, brought them to the United States so that people could see them.

Every once in a while twins are born that are joined together. Chang and Eng were so famous that now all babies joined together are called Siamese twins. It is possible to separate some of them. There are Siamese twins among cats and dogs and other animals, too. (See BARNUM, PHINEAS TAYLOR; TWINS.)

SIGNALING Many ways have been worked out of sending messages with signals. Some signals are so common that people do not think of them as important message bringers. Factory whistles are a good example. Traffic lights are another.

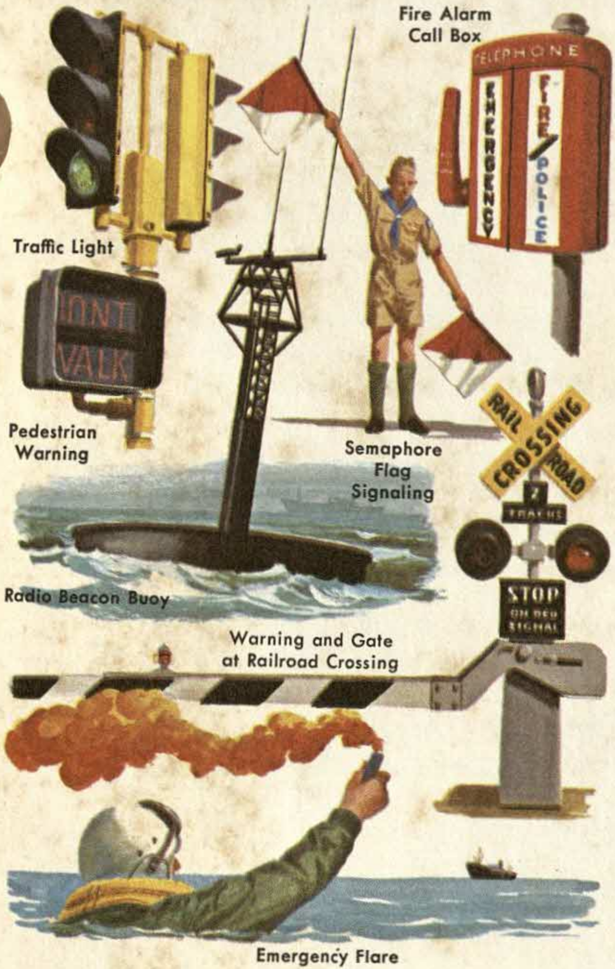
Factory whistles are one of a great number of ways of signaling with sound. Doorbells, sirens, foghorns, automobile horns, and school gongs are a few of the others. A lost hunter fires three shots into the air to call for help. In football games the referee blows a whistle to announce that a play is over. Tribesmen in Africa send



messages with "talking drums." Sound is a fast traveler, but it does not travel long distances well. Drum messages sent many miles must be repeated along the way.

Light was used as a signal long before there were any red and green traffic lights. The approach of the Spanish Armada was announced to the English centuries ago by bonfires. On the night of Paul Revere's famous ride in 1775 lanterns hung in Boston's Old North Church told patriots across the river how the British were coming.

The ancient Greeks sent messages by arranging flaming torches in racks. There was a different arrangement of torches for each letter. When Napoleon was fighting in sunny Egypt, his officers flashed messages to one another with mirrors. A mirror used in flashing a message is called a heliograph. "Heliograph" comes from the Greek words for "sun" and "write." Many hundreds of years before Napoleon's day the Persians "wrote with sunlight." They used their polished shields as mirrors. At sea today messages are often sent from ship to ship with blinker lights. Flares for indicating targets help in wartime. And in emergencies at sea or on land they serve as distress signals.



Smoke from fires can be used in signaling. The Indians were experts in this way of sending messages.

The U.S. Weather Bureau uses flags as weather signals. And ships send messages by using flags. An international flag code lets ships "talk" to one another even though the crews of the ships speak different languages. Wigwagging is a way of spelling out messages with flags.

Semaphores are much used along railroads as signals to trains. The position of the arm tells whether the track ahead is clear. Just before electricity was first used as a messenger, semaphores were used to send messages long distances. Stations were set up every few miles. An operator spelled out a message by arranging the semaphore arms in different positions. With spyglasses the operator at the next station read the message and sent it on.

Fog once made quite a difference in such a message. The English under Wellington were fighting the French under Napoleon. The message that came through to England was: "Wellington defeated." Fog had shut off two more words—"the French."

Sometimes signals are used even when people are close enough to talk easily to each other. Signals keep the message secret. In a baseball game, for instance, the catcher tells the pitcher with a signal what kind of ball to pitch.

Today direct communication by means of telephone, radio, telegraph, and television has taken the place of signaling for many purposes. But for some occasions these ways of sending word to others can never replace signals. (See AIRPORT; AIRWAYS; LIGHTHOUSE; RADIO; RAILROADS.)

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